



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

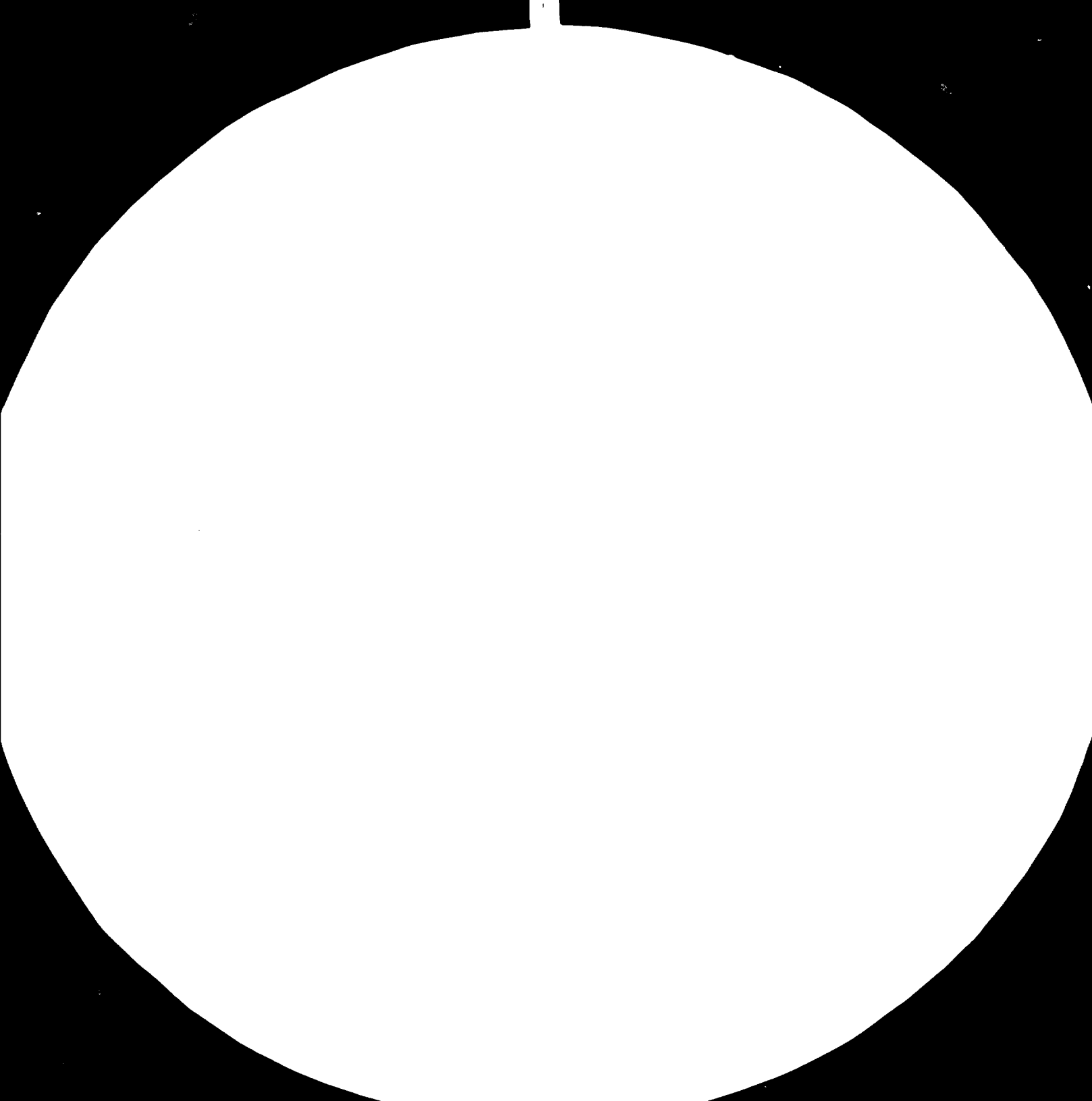
FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

13716

Distr.
RESTRICTED

UNIDO/IO/R.120
27 October 1983

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ENGLISH

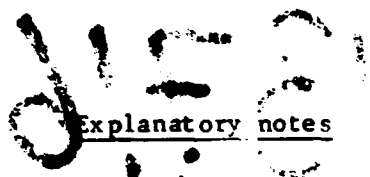
ASSISTANCE TO THE LIBYAN CEMENT FACTORY, BENGHAZI
TF/LIB/82/002
LIBYAN ARAB JAMAHIRIYA

Libya.

Mission report: Follow-up study on the introduction of
sulphate-resisting cement production

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



Explanatory notes

The following technical abbreviations are used in this report:

- ASTM American Society for Testing and Materials (specification)
- BS British Standard (specification)

- C₂F dicalcium ferrite
- C₂S dicalcium silicate
- C₃S tricalcium silicate
- C₃A tricalcium aluminate
- C₄AF tetracalcium aluminoferrite
- IR insoluble residue
- LOI loss on ignition
- LSF lime saturation factor

- AM alumina modulus
- HM hydraulic modulus
- LM lime modulus
- SM silica modulus

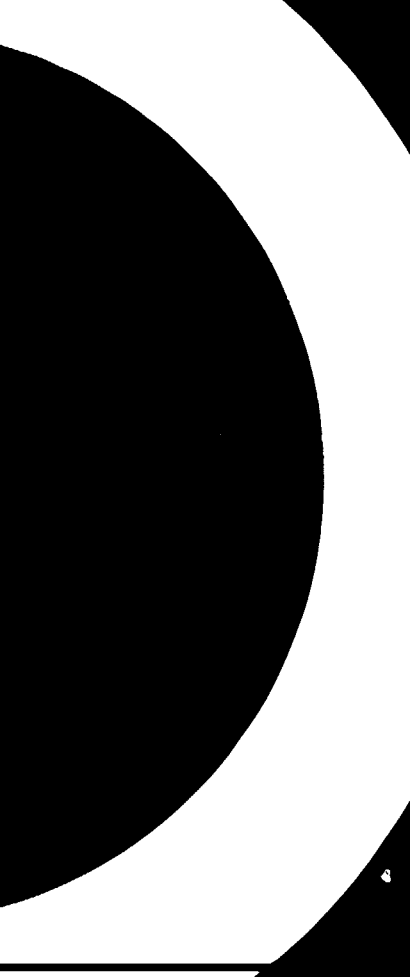
Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

ABSTRACT

This project, "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/82/002), 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. The project (formerly TF/LIB/75 002) has been in operation since 1975 and represents a new form of technical assistance with direct support to industry. The expert took over as co-ordinator of project activities in May 1980.

In 1981, the expert prepared a feasibility study to investigate the possibility of the Libyan Cement Company introducing the production of sulphate-resisting cement (SRC) using mainly local raw materials. The report on the feasibility study was issued in November 1981 (UNIDO/IO/R.17). The conclusions of the feasibility study were positive on both technological and economic grounds and the introduction of SRC production in the Benghazi Plant of the Libyan Cement Company was recommended. The present follow-up study is complementary to the feasibility study and goes further into the practical applications of introducing SRC production.

Theoretical raw-mix designs with three and four components were calculated. A computer was used to calculate all the possible raw-mix designs within a range of selected values for certain parameters. Laboratory investigations were carried out to evaluate the behaviour of the raw materials it is proposed to use and potential problems in SRC production were investigated. The steps taken to start actual production of SRC in the Benghazi Plant in 1983 are described.



CONTENTS

<u>Chapter</u>	<u>Page</u>
INTRODUCTION	7
SUMMARY OF FINDINGS AND RECOMMENDATIONS	8
I. TECHNICAL BACKGROUND TO THE PRODUCTION OF SULPHATE-RESISTING CEMENT	10
II. RAW-MIX DESIGNS	13
A. Designs using three raw materials	13
B. Designs using four raw materials	15
III. COMPUTER CALCULATION OF RAW-MATERIAL PROPORTIONING RANGES	18
IV. LABORATORY INVESTIGATIONS OF THE RAW MIXES	20
A. Investigation procedures	20
B. Raw mix I	22
C. Raw mix II	23
D. Raw mix III	24
E. Raw mix IV	25
F. Discussion of the results	26
V. POTENTIAL PROBLEMS INVESTIGATED	29
A. Clinker coating	29
B. Importance of the quantity of liquified material ..	30
C. Calculation of coating values	31
VI. STARTING PRODUCTION OF SULPHATE-RESISTING CEMENT AT LCC	35
A. Preparatory activities	35
B. Actions taken by LCC	36

	<u>Page</u>
<u>Annexes</u>	
I. Computerized raw mixes: group A	37
II. Computerized raw mixes: group B	65
III. Computerized raw mixes: group C	93
IV. Computerized raw mixes: group D	95
V. Reports issued under the project TF/LIB/75/002 or TF/LIB/82/002	96

	<u>Page</u>
<u>Tables</u>	
1. Chemical composition of group A raw materials	13
2. Raw-mix designs using three materials	14
3. Raw-mix designs using four materials	16
4. Chemical composition of raw materials used in the computer calculation of raw-mix designs (groups A and B)	18
5. Chemical analyses of raw mix I (types a and b)	23
6. Chemical analyses of raw mix II	24
7. Chemical analyses of raw mix III	25
8. Chemical analyses of raw mix IV	26
9. Insoluble residue and free lime content of samples tested	27
10. Combination of silica with alumina and lime in the samples tested	27

INTRODUCTION

This project, "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/82/002), 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. The project (originally TF/LIB/75/002) has been in operation since 1975 and represents a new form of technical assistance with direct support to industry. The expert took over as co-ordinator of project activities in May 1980.

In 1981, the expert prepared a feasibility study to investigate the possibility of the Libyan Cement Company (LCC) introducing the production of sulphate-resisting cement (SRC) using mainly local raw materials. The report on the feasibility study was issued in November 1981 (UNIDO/IO/R.17). The conclusions of the feasibility study were positive on both technological and economic grounds and the introduction of SRC production in the Benghazi Plant of the Libyan Cement Company was recommended. The present follow-up study is complementary to the feasibility study and goes further into the practical applications of introducing SRC production, which was in fact started by the LCC in 1983.

A list of all the reports issued so far under this project is given in annex V.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Findings

1. The raw materials which will be used in the production of sulphate-resisting cement (SRC) are limestone and marl, extracted from the LCC quarries in the Hawari area, sand from the Gialo area and Galmoya iron ore.
2. According to the theoretical raw-mix designs, it was found that these raw materials are suitable for the production of SRC. It was also found advisable from the economic point of view to use marl as a fourth component in high percentages (approximately 19.00 %) as the layer of marl caps the limestone in the LCC quarry and would anyway have to be removed to expose the limestone.
3. The study was based on producing SRC to comply with British standard specification BS 4027 in order to avoid the maximum limit of the alkali content of the cement produced specified by the American standard ASTM C 150. It is hoped that in the near future it will be possible to use the new Libyan standard specification for SRC, as this specification combines the BS and ASTM requirements.
4. Given the specifications governing the composition of SRC, a very wide range of variables for tricalcium silicate (C_3S), tricalcium aluminate (C_3A) and tetracalcium aluminoferrite (C_4AF) was fed into the computer to determine the proportions of the raw-material components to be used in the raw mix for producing SRC. The computerized data shows all the possibilities for producing SRC when changing one, two or more parameters as well as showing the range of proportions of raw materials that can be used. This computerized data will be a great help to LCC production personnel.
5. Laboratory investigations were carried out to evaluate the behaviour of the raw materials previously mentioned. The results of the burnability tests showed that the raw mixes tested were of normal burnability and of high reactivity according to the standard suggested by Polysius.
6. Coating tests and calculations indicated that there will be no serious problems in clinker-burning and that the coating will be deposited on the lining bricks in a normal way if the raw mix is designed within the limits indicated.
7. After much preparatory work and some modifications to the production lines, LCC started to produce sulphate-resisting cement in 1963. The production has run successfully with minor problems which it was possible to overcome.

Recommendations

1. To maintain a successful result, care has to be taken with the following processes:
 - (a) Mixing of raw materials has to be well done;
 - (b) Preblending of raw materials has to be within the required percentage limits;

(c) The fineness of the raw meal produced by the raw mills ought to be increased;

(d) Prehomogenization has to be carried out perfectly;

(e) Burning of the raw meal has to be correct.

2. The Libyan standard specification for SRC ought to be finalized and applied to the production of this cement.

3. The limitation ranges indicated in our computerized data should be followed.

4. The production of SRC requires intensive quality control of raw materials, preblended beds, ground raw meal and of the clinker produced.

I. TECHNICAL BACKGROUND TO THE PRODUCTION OF SULPHATE-RESISTING CEMENT

The production of sulphate-resisting cement by a clinkering process depends on the chemical composition of the mix, the physical state of the raw ingredients (e.g. fineness) and the temperature and length of burning. The chemical composition of sulphate-resisting cement (SRC) must fulfil certain requirements according to the standard specifications to ensure successful use of the cement produced.

For example, a limitation is placed on the lime content with the object of ensuring that the cement shall not contain an excess of lime over that which can combine with the acidic oxides, which could lead to unsoundness in the concrete. Accordingly, a proportioning formula, the lime modulus (LM), is provided for calculating the maximum amount of lime which can combine with the acidic oxides during burning. Under optimum conditions of manufacture (fineness of raw materials and clinkering temperature), the maximum amount of lime which can be combined in the clinker is expressed by the equation:

$$\text{CaO}_{(\text{max.})} = (2.8 \times \% \text{SiO}_2) + (1.2 \times \% \text{Al}_2\text{O}_3) + (0.65 \times \% \text{Fe}_2\text{O}_3)$$

The ratio of the effective lime content to the maximum possible lime content in the clinker is known as the "lime saturation factor" and is defined as:

$$\text{LSF} = \frac{\text{CaO}}{(2.8 \times \% \text{SiO}_2) + (1.2 \times \% \text{Al}_2\text{O}_3) + (0.65 \times \% \text{Fe}_2\text{O}_3)}$$

According to the British standard (BS 4027:Part 2:1972) the LSF of ordinary Portland cement and SRC have a LSF between 0.90 and 0.95 whereas high-early-strength cements (rapid hardening) are characterized by a LSF between 0.90 and 0.95. Kiln raw meal with a high LSF is difficult to burn. A raw mix with a low LSF indicates the presence of a high percentage of dicalcium silicate (C_2S) while all the silica content of a raw mix with a high LSF is attributable to the presence of C_3S . Raw mixes with a low LSF give a low-quality cement. It is worth noting that when the LSF or the silica modulus increases, this reduces the magnesium oxide (MgO) and alkali content and the raw meal will be hard to burn. Changing the LSF of the raw meal by 0.1% produces a change in the burnability equal to a change in the silica modulus of 0.1 of the same mix.

The relationship between the silica, alumina and iron-oxide contents of a cement is expressed as the silica modulus ($\text{SM} = \text{SiO}_2/\text{R}_2\text{O}_3$). The silica modulus usually lies between 1.5 and 3.2 and the most common figures for the SM are between 2.2 and 2.6. In SRC, it increases in some cases to 3.0 or more according to the silica present in the raw mix. As the silica modulus increases, chemical combination becomes more difficult especially when the ratio exceeds 3.0. Increase of the silica modulus impairs the burnability of the raw mix and also abrades and deteriorates the kiln linings. Increasing the silica modulus produces cements with slow setting and hardening properties. On the other hand, cements with a low silica modulus have excellent early strengths. However, raw mixes with a very low SM tend to produce clinker rings and kiln blockages, thus reducing clinker production to a great extent.

The ratio of alumina to iron oxide, known as the alumina modulus (AM), is in the range from 1.3 to 3.5 for normal Portland cement. It is usually preferred to keep the AM between 1.3 and 1.6 to obtain better clinker quality. The AM is utilized conventionally as an index of the degree of sulphate resistance. When the clinker has an AM less than 1.0, it is considered to be a sulphate-resisting cement. Iron in general, has a favourable influence on the formation of the cement compounds. A higher iron content leads to easier burning (and therefore cost reduction) and produces a hard, dense clinker.

When the AM is 0.64 (the value which corresponds to the ratio of molecular weight), the C_3A content is, in theory, nil and all the Al_2O_3 is combined in C_4AF . (This can be seen in the computer proportioning of the raw-material components given in annexes I-IV.)

A British standard specification covering sulphate-resisting Portland cements has existed since 1949. There was, at that time, no reliable direct test for sulphate resistance other than prolonged storage of concrete or mortar specimens in sulphate solutions and this type of test can hardly form the basis of a standard. Since then, experimental work and practical experience have shown that a considerable degree of sulphate resistance is conferred on Portland cement if the C_3A is limited to 3.5 which is the requirement of BS 4027:Part II:1972. In all other respects (except for fineness) sulphate-resisting Portland cement is an ordinary Portland cement (OPC) and the physical requirements for it are the same as those given in BS 12 for OPC.

According to the co-ordinator's recommendation, the SRC to be produced in the Libyan Cement Company has to comply with BS 4027. Therefore, all the tests and laboratory investigations have been based on this specification. In the meantime, there is a project for a Libyan standard specification which combines both the BS 4027 and the ASTM C 150 specifications. This combined specification would be very useful in the Libyan Arab Jamahiriya and it is hoped that the project will be officially finalized. A comparison between the BS 4027 and ASTM C 150 specifications is given here. ASTM C 150 includes two sulphate-resisting types of cement: Type II (for general use when moderate sulphate resistance is desired) and Type V (for use when high sulphate resistance is desired).

<u>Maximum limits</u>	<u>BS 4027</u>	<u>ASTM C 150</u>	
		<u>Type II</u>	<u>Type V</u>
C_3A (%)	3.5	8.0	5.0
$C_4AF + 2C_3A$ (%)	-	-	20.0
<u>Chemical composition</u>			
LSF (range)	0.66-1.02		
MgO (maximum %)	4.0	5.0	5.0
SO_3 (maximum %)	2.5	3.0	2.3
SiO_2 (maximum %)	-	21.0	-
Al_2O_3 (maximum %)	-	6.0	-
Fe_2O_3 (maximum %)	-	6.0	-
<u>Physical characteristics</u>			
a. <u>Fineness</u> (minimum cm^2/g)	2 500	2 800	2 800

b. Compressive strength
(minimum kg/cm²)

at 3 days	155	105	85
at 7 days	-	175	155
at 28 days	237	280	210

In contrast to OPC, SRC has the following advantages:

- (a) Improved chemical resistance to salts and sea water;
- (b) Low heat of hydration;
- (c) Lesser shrinkage.

II. RAW-MIX DESIGNS

Using the specifications given above governing the composition of SRC, some trials for raw-mix designs were carried out under the co-ordinator's supervision by the chemists of the Libyan Cement Company. This procedure was useful training for the chemists so that they can carry out such tests in the future and can follow up these trials when dealing with regular production of this type of cement. The raw-mix trials were calculated to determine the proportions of the raw-material components to be used for producing sulphate-resisting clinker with selected values for LSF, iron-oxide content, alumina content, silica modulus and alumina modulus.

Two groups of raw materials (groups A and B) were used for the trials. The raw-mix designs discussed here were based on the group A raw materials. These were analysed in the LCC laboratories and proved to have the chemical composition shown in table 1.

Table 1. Chemical composition of group A raw materials

Chemical characteristics	Raw materials			
	Limestone (%)	Gialo sand (%)	Iron oxide (%)	Marl (%)
SiO ₂	2.23	77.11	16.12	33.31
Al ₂ O ₃	0.58	2.75	10.38	8.5
Fe ₂ O ₃	0.35	1.02	62.5	3.6
CaO	51.86	8.86	1.12	26.32
MgO	1.48	1.40	0.20	1.20
SO ₃	0.15	0.40	-	0.07
Loss on ignition (LOI)	42.9	8.15	9.24	24.85

A. Designs using three raw materials

Trials were made using three of the available raw materials: limestone (from LCC quarries); sand (from Gialo); iron oxide (from Galmoya iron-ore mines). In these trials, the selected values were:

LSF ranging from 0.88 to 0.93
SM ranging from 2.2 to 4.0

Table 2 summarizes the raw-mix designs with three raw materials, showing the selected values for LSF and SM, the proportions of the materials in each design, the calculated chemical composition of the clinker and the clinker phases which would be produced.

Conclusions

1. As in the results of the feasibility study (UNIDO/IO/R.17), it must be said that it is difficult to design a viable raw mix using only three components.

Table 2. Raw-mix designs using three materials

Raw mix serial number	Selected values		Proportion of materials in raw mix			Chemical composition of clinker				Clinker phases			
	LSF	SM	Lime- stone (%)	Gialo sand (%)	Iron ore (%)	SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	CaO (%)	C ₃ S (%)	C ₂ S (%)	C ₃ A (%)	C ₄ AF (%)
1	0.88	2.2	76.96	15.53	7.51	22.92	2.54	7.88	63.62	56.46	23.12	6.59	23.97
2	0.88	3.2	78.11	17.05	4.84	24.24	2.20	5.37	65.10	58.26	25.53	3.25	16.34
3	0.90	2.0	77.08	14.77	8.15	22.19	2.62	8.48	63.67	60.83	17.74	7.42	25.81
4	0.90	2.5	77.85	15.77	6.38	23.06	2.39	6.83	64.64	62.10	19.26	5.22	20.78
5	0.90	2.8	78.20	16.22	5.59	23.45	2.29	6.09	65.09	62.67	19.96	4.23	18.52
6	0.92	2.0	77.54	14.47	7.99	21.88	2.59	8.35	64.16	65.59	13.24	7.27	25.41
7	0.92	3.0	78.83	16.14	5.03	23.32	2.21	5.56	65.79	67.82	15.68	3.56	16.93
8	0.92	3.5	79.23	16.65	4.12	23.76	2.09	4.70	66.30	68.51	16.45	2.40	14.3
9	0.93	3.0	79.05	15.98	4.97	23.15	2.20	5.52	66.03	70.2	13.41	3.51	16.79
10	0.93	3.8	79.64	16.73	3.63	23.80	2.53	4.24	66.75	67.86	17.04	0.48	12.89
11	0.93	4.0	79.75	16.88	3.37	23.93	2.00	3.99	66.90	71.45	14.70	1.48	12.14

2. It is also very important from the economic point of view to use marl as a fourth component and to use it in the maximum percentage possible while keeping the clinker produced within the standard specifications. The fact is that the layers of marly material overlie the limestone in the quarry and if the marl is not used it will anyway have to be transported and dumped in another place which will be reflected in increased costs for the SRC.

B. Designs using four raw materials

Raw mixes were also calculated with four components, using marl from the LCC quarries. The calculations involved changing the parameters for C_3S , C_3A , SM and AM to achieve SRC complying with the standard specification while using the maximum percentage of marl and the least amount of iron ore possible.

There were two sets of variants for the parameters. The selected values were as follows:

	<u>First set</u>	<u>Second set</u>
C_3S (range %)	60-69	50-69
C_3A (range)	1.6-1.9	1.6-2.5
SM (range)	1.35-1.5	1.4-2.5
AM	0.7	0.7

Table 3 shows the summary of the proportions in which the raw materials were used according to the changes in parameters indicated in the second set. The table also indicates the characteristics of the clinker based on the phases and chemical constituents shown.

Conclusions

1. The results show that SRC can be produced by the combination of four raw materials in different percentages. The characteristics of the clinker phases comply with the standard specifications, especially with BS 4027:Part 2:1972, which it is intended to use for the production of SRC on a large scale in the Libyan Cement Company. All the ten raw-mix designs comply also with the requirements of the ASTM C 150 (type V) specification that $2C_3A + C_4AF$ should not exceed 20.
2. Marl can be used in the proportion of approximately 19.0% when its alumina content does not exceed 8.5%. When the alumina content exceeds this value, care must be taken to decrease the percentage of marl in the raw mix. Accordingly, it is recommended that, whenever low-quality marl (of less than 8.5% alumina content) is found in the quarry, this should be reserved for the production of SRC as it can then be used in the proportion of 19% or more in the raw mix. A more rational exploitation of the quarry can also be achieved.
3. The Galmoya iron ore can be used successfully if it is used within the range 2.5-3.5%.
4. Gialo sand was used as one of the raw materials, essentially to supply the clinker phases with the silica component.
5. The selected value for C_3A was kept to a maximum of 2.5% to keep well on the safe side of the maximum C_3A content of the clinker produced as specified in BS 4027 (i.e. 3.5%).

Table 3. Raw-mix designs using four materials
(Percentage)

Raw mix serial number	Selected values				Proportion of materials in raw mix				Chemical composition of clinker				Clinker phases				
	C ₃ S	C ₃ A	SM	AM	Lime- stone	Gialo sand	Iron ore	Marl	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	C ₄ AF + 2C ₃ A
1	50	2.5	2.0	0.7	75.87	16.72	1.04	6.32	26.87	2.4	2.1	65.08	41.51	45.73	2.87	6.33	12.1
2	60	1.6	1.5	0.7	72.24	6.18	3.67	17.96	22.39	3.94	5.2	64.56	58.75	19.88	1.65	15.81	19.11
3	60	2.5	2.5	0.7	74.85	13.48	1.95	9.72	25.42	2.87	3.12	64.94	47.44	37.1	2.33	9.5	14.16
4	69	1.8	1.5	0.7	72.06	5.73	3.37	18.84	22.36	3.99	4.96	64.67	59.41	19.29	2.2	15.1	19.48
5	69	1.9	1.4	0.7	72.03	5.72	3.31	18.94	22.39	3.99	4.9	64.67	59.26	19.50	2.3	14.91	19.51
6	69	1.9	1.5	0.7	72.71	7.05	3.03	17.21	24.82	3.18	4.6	64.87	58.74	21.13	2.318	13.85	18.45
7	69	1.9	1.9	0.7	74.58	10.72	2.28	12.43	24.05	3.19	3.58	69.43	73.34	13.62	2.39	10.91	15.68
8	69	2.0	1.5	0.7	75.37	12.20	1.91	10.52	24.52	2.94	3.13	65.72	56.96	27.34	2.49	9.52	14.51
9	69	2.0	2.5	0.7	76.44	14.30	1.48	7.78	25.20	2.6	2.57	66.04	56.22	29.83	2.52	7.83	12.88
10	69	2.5	1.5	0.7	77.31	14.70	1.10	6.89	25.12	2.45	2.17	66.73	61.18	25.87	2.82	6.60	12.24

It should be noted that pyrite ash, which was originally proposed as an alternative component to Galmoya iron ore, has not been used in these raw-mix designs. This is because the Secretariat of Heavy Industries decided only to use local raw materials to avoid spending hard currency on imported items. Pyrite ash would have had to be imported.

III. COMPUTER CALCULATION OF RAW-MATERIAL PROPORTIONING RANGES

It is important to remind the reader that the effective method of increasing the sulphate resistance of Portland cement lies in the substitution of compound C_4AF for C_3A . This substitution of ferric oxide for alumina was suggested by Le Chatelier before the end of the nineteenth century leading later to the production of Erz and Ferrari cements in Germany and Italy respectively. These types of cement were very low in alumina-to-iron oxide ratio. There is clear evidence that a low C_3A content increases the resistance of a cement to attack from sulphate solutions and that there is a general correspondence between C_3A content and sulphate resistance.

In the light of these considerations and of the results of the raw-mix designs already calculated, a computer was used to determine and to confirm the proportions of the raw-material components to be used for producing clinker with selected values for the C_3S , C_3A and C_4AF phases. The selected values for these parameters were as follows:

Clinker phase	Percentage range		Percentage increase per step
	from	to	
C_3S	40.00	46.00	2.00
C_3A	00.00	3.50	0.10
C_4AF	10.00	15.00	1.00

Two groups of raw-mix designs (groups A and B) were calculated on the basis of four raw-material components. The chemical analysis of the raw materials used in groups A and B is shown in table 4.

Table 4. Chemical composition of raw materials used in the computer calculation of raw-mix designs (groups A and B) (Percentage)

Chemical composition	Raw material							
	Limestone		Sand		Iron ore		Marl	
	A	B	A	B	A	B	A and B	
SiO_2	2.23	0.4	77.11	69.69	6.12	13.37	33.31	
Al_2O_3	0.58	0.00	2.75	1.88	10.38	11.60	8.50	
Fe_2O_3	0.35	0.20	1.02	0.40	62.50	62.4	3.60	
CaO	51.86	53.76	8.86	13.44	1.12	1.40	26.32	
MgO	1.48	0.70	1.40	1.00	0.20	1.60	1.20	
SO_3	0.15	0.40	0.40	0.29	-	0.49	0.07	
LOI	42.9	43.95	8.15	12.20	9.85	10.09	24.85	

Another two groups of raw mixes (groups C and D) were calculated using only three raw materials, limestone, sand and iron ore. The chemical composition of these three materials in group C were the same as in group A, and their chemical composition in group D was the same as in group B. For groups C and D, the LSF and AM were varied according to the following selected values:

LSF ranging from 0.90-0.96 with an increase of 0.01 per step

AM ranging from 1.5-3.5* with an increase of 0.10 per step

Throughout the computer proportioning, the hydraulic modulus (HM) was used. This modulus has the following form:

$$HM = \frac{CaO}{SiO_2 + Al_2O_3 + Fe_2O_3}$$

The HM of cements, as indicated in the above formula, explains the relationship that exists between the percentage of lime on one hand and the combination of silica, alumina and iron oxide on the other. The hydraulic modulus of good-quality cement is approximately 2.0 as it ranges from 1.7-2.3. Cement with an HM below 1.7 usually results in low mortar and concrete strength while cement with an HM of more than 2.3 shows poor stability of volume (soundness). Accordingly, in order to produce high-quality cement, the hydraulic modulus in the computer calculations was selected to range from 1.9-2.0.

The computerized data on the proportioning of raw materials in these four raw-mix design groups, A, B, C and D are given in annexes I, II, III and IV respectively.

*In the computer calculations, realistic raw-mix designs only appeared for values of the alumina modulus up to 2.0.

IV. LABORATORY INVESTIGATIONS OF THE RAW MIXES

Laboratory investigations were carried out in the LCC laboratories to evaluate the behaviour of the raw materials combined in different proportions according to different raw-mix designs. Investigations were also carried out to evaluate the burnability of the raw materials.

The facility with which the components of a SRC raw mix combine is designated as the burnability. The burnability of the raw materials can be readily ascertained by estimating the percentage of free lime or uncombined calcium oxide which remains in the product following heat treatment. In the present investigations, the burnability of each raw mix was evaluated by determining both the uncombined lime and the insoluble residue after subjecting the raw mix to a specific burning temperature. The insoluble residue represents the aluminosilicates of the clay minerals or the silica which did not participate in chemical combination.

Evaluation of the burnability of the raw materials involved the following:

- (a) Use of a raw mix characterized by a high lime-saturation factor of 98;
- (b) Burning the raw mixes at different temperatures of 1350° and 1400°C;
- (c) Using different percentages of sand, iron ore and marl in order to evaluate their behaviour during burning.

The principle upon which the above-mentioned conditions were designed is that a mixture with a high lime-saturation factor requires a higher heat consumption for clinker burning. Accordingly, the reactivity of the raw materials under these severe test conditions will give a more realistic picture of their burnability than if tested under ideal conditions with a low lime-saturation factor, higher fineness, higher temperature and longer burning time.

Before the laboratory tests were carried out, representative samples of each of the four raw materials were collected and analysed. The results of the chemical analysis are those given in table 4 for group B, since the analysis results were also used in the computer calculations for ease of comparison.

Various theoretical raw-mix calculations based on the four components were carried out, leading to the same results and conclusions as the four-component raw-mix designs described in chapter II, section B.

A. Investigation procedures

Test specimens of the four materials were prepared in the LCC laboratories according to the following procedures:

- (a) Each of the raw materials, limestone, sand and marl were dried and then pulverized. (A pre-ground sample of iron ore was used.) Grinding was carried out in the LCC laboratory ball mill until all the raw materials could pass a 90-micron sieve. Grinding times and humidity of the samples were as follows:

<u>Raw material</u>	<u>Grinding time (minutes)</u>	<u>Humidity of the pulverized sample (percentage)</u>
Limestone	35	0.18
Sand	40	0.43
Marl	20	2.45
Iron ore	-	0.92

(b) Samples of the materials were then thoroughly mixed together in the proportions determined by the raw-mix design. Mixing was carried out in the laboratory mill;

(c) Enough water was added with continuous mixing until a plastic mass was obtained (in the form of viscous slurry);

(d) The viscous slurry was then dried at a temperature of not more than 80°C until the slurry became semi-dry;

(e) The semi-dry plastic material was then formed by hand into balls of 1 to 1.5 cm diameter;

(f) The balls were dried again at 120°C until they were completely dry (no moisture content);

(g) These dried balls were transferred to platinum dishes;

(h) Burning of these balls was carried out in a muffle furnace of the Heraeus type at 1350° or 1400°C for one hour. The temperature of the furnace was increased gradually from room temperature till it reached the selected burning temperature at which it stayed for one hour. Then the furnace was switched off and the temperature gradually decreased till it reached room temperature again;

(i) The dishes were introduced into the muffle furnace again at 1,000°C in order to be able to test the effects of quenching;

(j) The products of burning (clinker balls) were then cooled rapidly;

(k) After cooling, the clinker balls were ground to pass a 100-micron sieve;

(l) The resulting pulverized material was then analyzed for insoluble residue and free lime.

Insoluble residue

The analysis of insoluble residue in the cement is based on treating one gram of the cement in an acid solution composed of 10 ml of concentrated hydrochloric acid and 40 ml of water. The insoluble residue is digested with 30 ml of 2N-strength sodium carbonate. The residue is ignited. The ignited material represents the insoluble material in the cement.

Free lime

The determination of free lime in cement or clinker is based on the solution of the calcium oxide in ethylene glycol at 70°C, and the subsequent titration of the dissolved oxide with standardized acid. One gram of the

ground clinker and 40 ml of ethylene glycol were heated in a water bath at 80°C for 30 minutes. The solution was then filtered through a sintered glass funnel and the residue was washed twice with 10 ml amounts of ethylene glycol. The filtrate of the extraction and washings were titrated with 0.1N-strength hydrochloric acid, using bromcresol green as an indicator.

These test procedures were carried out on four different raw-mix designs.

B. Raw mix I

In raw mix I, the co-ordinator wanted to test a raw mix with the highest possible lime-saturation factor. Accordingly the following proportions of the raw materials were used:

<u>Raw material</u>	<u>Percentage</u>	<u>Weight (g)</u>
Limestone	73.0	219
Sand	7.2	21.6
Iron oxide ore	3.2	9.6
Marl	<u>16.6</u>	<u>49.8</u>
Total	100.0	300.0

The sample was then thoroughly mixed and the carbonate content was determined. It was found to be about 80%.

The trial was done again after recalculating the carbonate content of all the samples and the carbonate content required in the raw mix. The proportions of the raw materials were then changed as follows:

<u>Raw material</u>	<u>Percentage</u>	<u>Weight (g)</u>
Limestone	69.52	219
Sand	10.03	31.6
Iron oxide ore	4.63	14.6
Marl	<u>15.82</u>	<u>49.8</u>
Total	100.0	315.0

The carbonate content of this mixture was found to be 77.5%.

The first raw mix was burnt at a temperature of 1350°C. The clinker balls produced after burning were differentiated into two types. About 65% of the balls were hard burnt and were dark black in colour while about 35% of the balls were black but spotted with whitish material. The spots may be attributed to a failure in mixing the sample sufficiently well. As a result, the carbonate content increased in one part while it decreased in the other.

The two types of clinker balls were separated and each type was then processed separately under the designations raw mix Ia (the 65% described above) and raw mix Ib (the 35%). The results of the analyses for insoluble residue and free lime were as follows:

<u>Type of analysis</u>	<u>Raw mix Ia (%)</u>	<u>Raw mix Ib (%)</u>
Free lime	0.73	1.74
Insoluble residue	0.31	0.66

The results of the chemical analyses carried out for both types of clinker are summarized in table 5.

Table 5. Chemical analyses of raw mix I (types a and b) (percentage)

<u>Composition and characteristics</u>	<u>Raw Mix Ia</u>	<u>Raw Mix Ib</u>
SiO ₂	20.57	20.00
Al ₂ O ₃	3.74	4.38
Fe ₂ O ₃	5.56	5.60
CaO	64.96	64.4
MgO	1.40	2.6
SO ₃	0.35	0.38
K ₂ O	0.28	0.28
Na ₂ O	0.27	0.27
LOI	0.22	0.89
LSF	98	99
SM	2.21	2.00
AM	0.67	0.78
C ₃ S	75.67	73.1
C ₂ S	0.88	0.48
C ₃ A	0.65	2.31
C ₄ AF	16.90	17.02

C. Raw mix II

In this raw mix, the co-ordinator wanted to test a raw mix similar in its behaviour to the raw mixes usually used in cement plants, especially in terms of the carbonate content. The following proportions of raw materials were used:

<u>Raw material</u>	<u>Percentage</u>	<u>Weight (g)</u>
Limestone	67.5	270
Sand	10.5	42
Iron-oxide ore	5.0	20
Marl	<u>17.0</u>	<u>68</u>
Total	100.0	400

The carbonate content in this raw mix was estimated to be 76%.

The same test procedures were followed to investigate the burnability and the characteristics of the clinker produced. However, more water was added to produce a more liquid slurry, which would be easier to mix, to ensure a thorough combination of the raw materials.

Burning was carried out at 1400°C for one hour.

The clinker produced was analysed and the free lime and insoluble residue were as follows:

Free lime	0.39%
Insoluble residue	0.11%

The results of the chemical analyses of the clinker produced are compared with the results of the theoretical calculations in table 6.

Table 6. Chemical analyses of raw mix II
(Percentage)

Composition and characteristics	Analysis of clinker produced	Theoretical calculation
SiO ₂	21.62	21.25
Al ₂ O ₃	4.06	3.453
Fe ₂ O ₃	5.44	6.075
CaO	63.24	65.647
MgO	2.2	
SO ₃	0.41	
K ₂ O	0.28	
Na ₂ O	0.27	
LOI	0.39	
LSF	93	97
C ₃ S	60.90	73.84
C ₂ S	13.91	5.226
C ₃ A	1.71	1.128
C ₄ AF	16.54	18.486

D. Raw mix III

For this raw mix, an attempt was made to increase the silica content and to decrease the iron-oxide content while keeping the proportion of marl in the raw mix half way between that in mixes I and II. The following raw material proportions were used in the third raw mix:

<u>Raw material</u>	<u>Percentage</u>	<u>Weight (g)</u>
Limestone	68.0	272
Sand	12.0	48
Iron-oxide ore	4.0	16
Marl	<u>16.0</u>	<u>64</u>
Total	100.0	400

The carbonate content of the raw mix was 76.25%.

Burning of the raw mix was carried out at 1400°C for one hour.

The free lime and the insoluble residue of the clinker produced were as follows:

Free lime	0.39%
Insoluble residue	0.13%

Table 7 shows the chemical analyses of the clinker compared to the theoretical calculation.

Table 7. Chemical analyses of raw mix III
(Percentage)

Composition and characteristics	Analysis of clinker produced	Theoretical calculation
SiO ₂	21.98	22.165
Al ₂ O ₃	3.71	3.188
Fe ₂ O ₃	4.92	5.063
CaO	64.4	65.99
MgO	2.2	
SO ₃	0.39	
K ₂ O	n.d. ^{a/}	
Na ₂ O	n.d.	
LOI	n.d.	
LSF	93	95
SM	2.55	2.686
AM	0.75	0.63
C ₃ S	63.76	71.534
C ₂ S	12.73	9.582
C ₃ A	1.65	0.118
C ₄ AF	14.95	15.407

^{a/} n.d. not determined

E. Raw mix IV

In this raw mix, the co-ordinator tried to increase the percentage of the marl and to decrease the percentage of iron oxide as follows:

<u>Raw material</u>	<u>Percentage</u>	<u>Weight (g)</u>
Limestone	67.0	268
Sand	12.7	50.8
Iron-oxide ore	3.0	12
Marl	<u>17.3</u>	<u>69.2</u>
Total	100.0	400.0

The carbonate content of this raw mix according to the carbonate analysis was 76.50%.

Burning of the raw mix was carried out at 1400°C for one hour.

The free lime and the insoluble residue as shown in the chemical analyses of the clinker were as follows:

Free lime 0.50%
 Insoluble residue 0.13%

Table 8 shows the results of the chemical analyses of the clinker produced compared to the theoretical calculations.

Table 8. Chemical analyses of raw mix IV
 (Percentage)

Composition	Analysis of clinker produced	Theoretical calculation
SiO ₂	23.28	23.344
Al ₂ O ₃	3.37	3.192
Fe ₂ O ₃	4.16	4.159
CaO	63.84	65.837
MgO	2.2	
SO ₃	0.51	
K ₂ O	n.d. ^{a/}	
Na ₂ O	n.d.	
LOI	0.22	
LSF	87	92
SM	2.13	3.176
AM	0.81	0.767
C ₃ S	55.07	63.217
C ₂ S	23.45	19.236
C ₃ A	2.02	1.422
C ₄ AF	12.65	12.656

^{a/} n.d. not determined.

F. Discussion of the results

Insoluble residue and free lime

The insoluble residue (IR) and free lime content of the tested raw-mix samples burned at 1350°C or 1400°C and then quenched are reported together in table 9.

Table 9. Insoluble residue and free lime content of samples tested (Percentage)

Burning temperature (°C)	Mix I				Mix II		Mix III		Mix IV	
	Type a		Type b		IR	Free lime	IR	Free lime	IR	Free lime
	IR	Free lime	IR	Free lime						
1350	0.31	0.73	0.66	1.74						
1400					0.11	0.39	0.13	0.39	0.13	0.50

Table 9 shows that both the insoluble residue and the uncombined calcium oxide decrease at the higher burning temperature, indicating the progress of chemical combination with increased heat.

The insoluble residue represents the uncombined or free aluminosilicates of the clays and/or free quartz. Table 10 gives a calculation of the extent of the combination of silica with alumina and lime in the raw mixes burned at 1350°C and 1400°C.

Table 10. Combination of silica with alumina and lime in the raw mixes tested (Percentage)

Chemical components	Mix I		Mix II	Mix III	Mix IV
	a	b			
<u>SiO₂ + Al₂O₃</u>					
Original content, dry	16.0	16.0	15.9	16.3	17.1
Original content, ignited	24.31	24.38	25.68	25.69	26.65
IR at 1350°C (Ia and b) and 1400°C (II, III, IV)	0.31	0.66	0.11	0.13	0.13
<u>IR x 100</u>					
Original content, ignited	1.2	2.75	0.43	0.51	0.49
<u>CaO</u>					
Original content, dry	42.95	42.95	42.24	42.44	42.33
Original content, ignited	64.96	64.40	63.24	64.5	63.84
Free CaO at 1350°C (Ia, b) and 1400°C (II, III, IV)	0.73	1.74	0.39	0.39	0.50
<u>Free CaO x 100</u>					
Original CaO, ignited	1.12	2.7	0.62	0.61	0.78

The calculations in table 10 show the following:

(a) Between 97.25 and 98.8% of the $Al_2O_3 + SiO_2$ present in the raw mixes had combined at $1350^\circ C$ whereas about 99.5% of these oxides had combined at $1400^\circ C$;

(b) From 97.25 to 99.4% of the original calcium oxide had combined with the acidic oxides;

(c) The free lime data for mixes Ia and Ib indicate clearly that raw mixes with a high LSF (more than 98%) show less reactivity and are always in need of a higher burning temperature. On the other hand, the raw mixes containing normal LSF (more than 90%) show better reactivity as they yield much less uncombined calcium oxide;

(d) Comparing mixes II, III and IV, it can be seen that increasing the silica content (more marl and sand in raw mix IV) yielded more free lime which indicates a decrease in LSF and lower reactivity. needing more heat to accelerate the reaction between the free silica present and the other oxide ($CaO + Al_2O_3 + Fe_2O_3$);

(e) Decreasing the percentage of iron oxide was reflected in an increase in the amount of free CaO . This means that more heat is required to increase the percentage of the liquid phase in the clinker produced.

Despite the fact that the raw mixes were burned for one hour (due to lack of personnel and equipment), the very low percentages of free lime obtained in the present investigations indicate that in general the four mixes are of normal burnability and of very high reactivity according to the standards suggested by Polysius. Polysius considers that raw mixes with a LSF of 95 to 98 are evaluated as normally burnable according to the following free lime contents:

Free lime of 12-16% on burning for 15 min. at $1350^\circ C$

Free lime of 8-12% on burning for 15 min. at $1400^\circ C$

Free lime of 4-8% on burning for 15 min. at $1450^\circ C$

Free lime of 2-4% on burning for 15 min. at $1500^\circ C$

V. POTENTIAL PROBLEMS INVESTIGATED

A. Clinker coating

Sand, which is mainly formed of free silica (quartz), will be used as a main raw-mix component to provide the necessary SiO_2 in the SRC raw mix. The idea of using this sand in the kiln raw meal caused some doubts among the Libyan Cement Company authorities. To be on the safe side, the co-ordinator asked the LCC to send samples of the raw materials to be tested in the brick factory's laboratories or anywhere else they prefer, although the co-ordinator himself was convinced that the effect of the sand on the refractory bricks of the kiln lining would be slight.

There is no doubt about the fact that free silica in the raw mix could cause problems in kiln behaviour. Unless there is a sufficient amount of flux (usually iron), coating will not be formed and deposited on the refractory lining bricks and the bricks will be liable to rapid deterioration from the abrasive effect of the free silica (coarse sand). When this happens, the thickness of the refractory bricks is reduced, radiation through the kiln shell increases and more energy is required to burn the clinker.

For this reason, it is intended to use a small percentage of iron-oxide ore in the raw-mix design to enable the highly siliceous sand and other siliceous raw material (marl) to fuse and increase the liquid phase, which will encourage the formation of coating on the refractory lining and will keep down energy consumption.

In practice, the effect of free silica in the raw mix is compensated not only by the action of iron oxide, but also by the presence of some other mineralogical constituents deriving from the clayey materials, alkalies and magnesia content.

Generally it is preferable not to exceed a proportion of free silica in the mix of 3%. This percentage partly depends on the particle size (fineness) of the sand and the fineness and homogeneity of the raw meal entering the kiln.

In view of this, it is recommended that careful attention should be paid to the following:

- (a) Good preblending of the raw materials before grinding;
- (b) Correction of the raw-mix ratios during grinding;
- (c) Grinding the raw materials well and more finely than is usually done in producing normal Portland cement;
- (d) Prehomogenizing the raw mix perfectly before feeding the kiln as the preblending and prehomogenization smooth out deviations in the raw mix and provide the kiln with a raw mix of constant composition and properties.

It should be noted here that, as shown in the computerized raw-mix designs, deviations in the kiln feed, especially of the calcium-carbonate content, ought not to exceed 0.2% since an increase of 1.0% of CaCO_3 will increase the C_3S by 13% and reduce C_2S by about 11.5%. Inhomogeneity of the kiln feed will cause disturbances in the burning process and the coating stability.

B. Importance of the quantity of liquified material

As reference has been made above to the liquid phase, it is necessary to explain what this means.

The liquid phase found in the clinker is governed by the presence of alumina, iron oxide, magnesia and alkalies. These accelerate the fusion and decrease the melting point of the other components. They are known as fluxes. The oxides like magnesia, when found in higher percentages than required, tend to transform the raw mix in the burning zone into balls which disturbs the kiln behaviour and produces unsound cement in some cases. The alkalies, which derive from the argillaceous raw materials usually present in cement raw mixes, promote the formation of coating in the kiln because of their high fluxing character. It is preferable to use raw mixes rich in fluxes (especially alumina, iron oxide and limited percentages of the alkalies and magnesia) as these will help in promoting the chemical reaction between the raw-mix components.

Raw mixes with low silica and alumina ratios contain a higher percentage of fluxing agents and produce a liquid phase which easily builds up coating on the refractory lining of the kiln. Such a raw mix is easily burnable and produces clinker of dense character. Care has to be taken not to increase the fluxing components to too large a percentage as the clinker produced from a raw mix too rich in fluxing agents will be viscous in the burning zone leading to sticky balling and clinker-ring formation.

On the other hand, raw mixes with high silica and alumina ratios have low quantities of fluxes and a low liquid phase. Accordingly, the depositing of clinker coating on the refractory lining will be minimal leading to high radiation through the kiln shell. The clinker produced is difficult to burn in the sintering zone as well as being relatively porous and grindable.

The figure of 25% of liquid phase in the clinker produced is accepted as the ideal one from the point of view of the kiln lining, fuel saving during burning and economical clinker grinding. The liquid phase percentage can usually be calculated by the Lea and Parker formula as follows:

- (a) Liquid phase to be formed at 1450°C, when the AM is higher than 1.38
= $3.0 \text{ Al}_2\text{O}_3 + 2.25 \text{ Fe}_2\text{O}_3 + \text{K}_2\text{O} + \text{Na}_2\text{O} + \text{MgO}$;
- (b) When the AM is lower than 1.38
= $8.5 \text{ Al}_2\text{O}_3 - 5.22 \text{ Fe}_2\text{O}_3 + \text{K}_2\text{O} + \text{Na}_2\text{O} + \text{MgO}$.

Lea stated that in the case of raw mixes where the amount of liquid increases slowly with temperature, the clinkering range may be fairly wide. In those mixes where the rate of increase of the liquid phase with temperature is rapid, the clinkering range will be small. Sulphate-resisting clinker with its high iron content is an example of the latter type.

The formulas given above can be applied to estimate the expected percentage of the liquid phase that will be present in the sulphate-resisting clinker. The first two raw-mix samples used in our laboratory test require the second formula as follows:

Raw mix Ia

$$(8.5 \times 3.74) - (5.22 \times 5.56) + 0.28 + 0.27 + 1.4 = 31.79 - 29.023 + 0.28 + 0.27 + 1.4 = 4.717$$

Raw mix Ib

$$(8.5 \times 4.38) - (5.22 \times 5.6) + 0.28 + 0.27 + 2.6 = \\ 37.23 - 29.232 + 0.28 + 0.27 + 2.6 = 11.148$$

Raw mix II

$$(8.5 \times 4.06) - (5.22 \times 5.44) + 0.28 + 0.27 + 1.4 = \\ 34.51 - 28.3968 + 0.28 + 0.27 + 1.4 = 8.063$$

These results show that the burning of these raw mixes will require a higher temperature.

In summary, it is an essential task of the liquified material in the clinker to promote the formation of tricalcium silicate. In the rotary kiln, a limited amount of liquified material is also desirable, since it facilitates the formation of deposit and thus contributes to the protection of the lining against rapid wear. The tricalcium aluminate, which forms the liquefied material during cooling, also accelerates the setting of the cement. The advantageous characteristics of the liquified material are, however, accompanied by important disadvantages. One of these, which is generally accepted as unavoidable, is the high grinding resistance which it gives to the clinker and which then demands a high energy consumption during grinding.

C. Calculation of coating values

The quality and the stability of the coating likely to be produced in the clinker during burning can be judged by applying the following Knopicky formulas for coating value:

(a) $(C_3A + C_4AF) + 0.2 C_2S + 2F$ (for AM more than 1.38);

(b) $(C_2F + C_4AF) + 0.2 C_2S + 2F$ (for AM less than 1.38).

C_2F and the other clinker phases can be calculated using Bogue's formula for clinker with an iron modulus of 0.64 (rich in iron oxide or no C_3A) as follows:

$$C_3S = 4.071 CaO - 7.602 SiO_2 - 4.475 Al_2O_3 - 2.863 Fe_2O_3$$

$$C_2S = 2.867 SiO_2 - 0.754 C_3S$$

$$C_2F = 1.702 Fe_2O_3 - 2.665 Al_2O_3$$

$$C_4AF = 4.766 Fe_2O_3$$

The percentage of free CaO should be subtracted from the overall CaO content.

Using the Knopicky and Bogue formulas, the phase contents and coating value of the raw mixes are calculated below.

Raw mix Ia

The phase contents are:

$$\begin{aligned} C_3S &= (4.071 \times 64.23) - (7.602 \times 20.57) - (4.475 \times 3.74) - (2.863 \times 5.56) \\ &= 261.48 - 156.37 - 16.74 - 15.92 = 72.45\% \end{aligned}$$

$$C_2S = (2.867 \times 20.57) - (0.754 \times 72.45) = 58.974 - 54.63 = 4.344\%$$

$$C_2F = (1.702 \times 5.56) - (2.665 \times 3.74) = 9.463 - 9.967 = -0.504\%$$

$$C_4AF = 4.766 \times 5.56 = 26.498\%$$

The coating value is:

$$\begin{aligned} (-0.504 + 26.498) + (0.2 \times 4.344) + (2 \times 5.56) &= \\ 25.994 + 0.87 + 11.12 &= 37.98 \text{ i.e. } 38 \end{aligned}$$

Raw mix Ib

The phase contents are:

$$\begin{aligned} C_3S &= (4.071 \times 62.66) - (7.602 \times 20.00) - (4.475 \times 4.38) - (2.863 \times 5.6) \\ &= 255.1 - 152.04 - 19.6 - 16.0 = 67.46\% \end{aligned}$$

$$C_2S = (2.867 \times 20) - (0.754 \times 67.46) = 57.34 - 50.86 = 6.5\%$$

$$C_2F = (1.702 \times 5.6) - (2.665 \times 4.38) = 9.53 - 11.673 = -2.143\%$$

$$C_4AF = 4.766 \times 5.6 = 26.69\%$$

The coating value is:

$$\begin{aligned} (-2.143 + 26.69) + (0.2 \times 6.5) + (2 \times 5.6) &= \\ = 24.547 + 1.3 + 11.2 &= 37.0 \end{aligned}$$

The coating values for raw mixes Ia and Ib, 38 and 37, are very high. These values indicate that the lining bricks will be covered with a very rich clinker coating. It may be that, with these high values, the coating will grow to form clinker rings, creating problems for the behaviour of the kiln.

Raw mix II

The phase contents are:

$$\begin{aligned} C_3S &= (4.071 \times 62.24) - (7.602 \times 21.62) - (4.475 \times 4.06) - (2.863 \times 5.44) \\ &= 253.38 - 164.36 - 18.17 - 15.57 = 55.28\% \end{aligned}$$

$$C_2S = (2.867 \times 21.62) - (0.754 \times 55.28) = 61.98 - 41.68 = 20.3\%$$

$$C_2F = (1.702 \times 5.44) - (2.665 \times 4.06) = 9.26 - 10.82 = -1.56\%$$

$$C_4AF = 4.766 \times 5.44 = 25.93\%$$

The coating value is:

$$\begin{aligned} (-1.56 + 25.93) + (0.2 \times 20.3) + (2 \times 5.44) &= \\ = 24.37 + 4.06 + 10.88 &= 39.31 \end{aligned}$$

As in raw mix Ia and b, the coating value here is excessively high.

Raw mix III

The phase contents are:

$$C_3S = (4.071 \times 64.1) - (7.602 \times 21.98) - (4.475 \times 3.71) - (2.863 \times 4.92) \\ = 260.95 - 167.1 - 16.6 - 14.08 = 63.17\%$$

$$C_2S = (2.867 \times 21.98) - (0.754 \times 63.17) = 63.0 - 47.63 = 15.37\%$$

$$C_2F = (1.702 \times 4.92) - (2.665 \times 3.71) = 8.37 - 9.88 = -1.51\%$$

$$C_4AF = 4.766 \times 4.92 = 23.448\%$$

The coating value is:

$$(-1.51 + 23.448) + (0.2 \times 15.37) + (2 \times 4.92) \\ = 21.938 + 3.074 + 9.84 = 34.8$$

Here, the coating value is somewhat above the ideal limit (32-33) but less than 35.

Raw mix IV

The phase contents are:

$$C_3S = (4.071 \times 63.34) - (7.602 \times 23.28) - (4.475 \times 3.37) - (2.863 \times 4.16) \\ = 257.857 - 176.974 - 15.08 - 11.9 = 53.9\%$$

$$C_2S = (2.867 \times 23.28) - (0.754 \times 53.9) = 66.744 - 40.64 = 26.1\%$$

$$C_2F = (1.702 \times 4.16) - (2.665 \times 3.37) = 7.08 - 8.98 = -1.9\%$$

$$C_4AF = 4.766 \times 4.16 = 19.82\%$$

The coating value is:

$$(-1.9 + 19.82) + (0.2 \times 26.1) + (2 \times 4.16) = 17.93 + 5.22 + 8.32 = 31.47$$

The following facts should be noted:

- (a) The normal range of coating values is between 25 and 35;
- (b) The optimum coating performance lies between 32 and 33;
- (c) Coating values of less than 28 imply poor and unstabilized coating;
- (d) Coating values of more than 35 imply rich and excessive coating leading to clinker-ring formation.

It can be seen therefore that the ideal coating value falls between those of the last two raw mixes (III and IV) and that the optimum raw-mix design would be the average of those two mixes, as follows:

Components	Raw mix	(Percentage)	
	III	IV	Average of III and IV
Limestone	68.0	67.0	67.6
Sand	12.0	12.7	12.35
Iron ore	4.0	3.0	3.5
Marl	16.0	17.3	16.65

Alternative calculations can be made by applying the following formula:

$$(\text{SiO}_2 - 20) \times (2.8 + \text{Fe}_2\text{O}_3)$$

With this formula, the coating value showing the optimum coating performance was found to be more than 7.

Applying this formula to the clinker produced in the raw-mix design tests, the following coating values can be reached:

Raw mix Ia:

$$(20.57 - 20) \times (2.8 + 5.56) = 7.156$$

Raw mix Ib:

$$(20.00 - 20) \times (2.8 + 5.6) = 5.6$$

Raw mix II:

$$(21.62 - 20) \times (2.8 + 5.44) = 9.976$$

Raw mix III:

$$(21.98 - 20) \times (2.8 + 4.92) = 10.464$$

Raw mix IV:

$$(23.28 - 20) \times (2.8 + 4.16) = 13.344$$

Using this formula, the best result is that of raw mix IV.

The bricks used at present in the LCC kilns, especially in the burning zones, are magnesite or magnesite-chrome bricks. Given the results of the coating value investigations, there should be no problems about using the same quality of refractory bricks for both normal Portland cement and SRC production. However, the co-ordinator recommended additional coating tests under graduated and different high temperatures to be carried out under normal production conditions. He recommended that samples of the raw materials to be used should be sent to the different companies from which LCC imports its refractory bricks so that they can carry out such tests and recommend the most suitable bricks for installation in the burning as well as the transitional zone.

VI. STARTING PRODUCTION OF SULPHATE-RESISTING CEMENT AT LCC

A. Preparatory activities

Both the Secretariat of Heavy Industries and the co-ordinator were in favour of the LCC starting to produce SRC since both the previous feasibility study and the present laboratory investigations had confirmed that the raw materials available were suitable for SRC production. The co-ordinator submitted many proposals for starting production. However, the LCC authorities were reluctant to start for the following reasons:

(a) There were no personnel in LCC trained for the production and quality control of SRC;

(b) The raw mills of the Benghazi Cement Plant, especially the feeding systems, were in need of some modifications to process four components instead of the two currently processed;

(c) Marketing of the SRC after production might present difficulties.

All these matters were discussed with Izzeddin A. El Ghadamsi (Secretary of the People's Committee), Abdul-Latif Gomma (Technical Manager) and Khalifa El-Ebeidi (Production Manager). The co-ordinator attended a meeting which was held in September 1982 at LCC headquarters, chaired by Ali El Gheriani, Under-Secretary of Heavy Industries. The meeting discussed the need for the production of large quantities of SRC to supply one of the biggest projects in the country, and also what actions LCC would need to take before production could be started. All difficulties and problems which might arise in SRC production were discussed. By the end of the meeting, agreement was reached on the following:

(a) That SRC production should start at the beginning of 1983;

(b) That production of SRC should start at that time on the first production line of the Benghazi Cement Plant and that the second production line at Benghazi should begin SRC production in mid-1983, the intention being that the first production line would produce SRC the whole year round and that the second production line would only produce SRC for six months in the year;

(c) That action should be taken as soon as possible to arrange to purchase Gialo sand and Galmoya iron ore but that no further action would be taken to import pyrite ash;

(d) That the modifications required in the feeding system of Benghazi raw mill I should be taken in hand so as to be finished before the testing period (December 1982);

(e) That the necessary spare parts for modifying the feeding system of Benghazi raw mill II have to be ordered at once so as to carry out these modifications before June 1983;

(f) That SRC production will be based on British Standard Specification 4027. Although it would be easier to follow the ASTM specifications for type V cement, the problem is that this standard specifies a maximum alkali content of 0.6%. It was agreed to encourage the Libyan authorities concerned to issue the Libyan Final Project of SRC Specification, which will combine the other two standards;

(g) That LCC must deal with all the subsidiary requirements such as cost studies, packaging, marketing, training etc.

B. Actions taken by LCC

After the meeting described above, LCC took active steps towards starting production of SRC.

UNIDO was contacted to investigate the possibility of sending out three burners acquainted with SRC production either from Poland or somewhere else. In addition, a chemist was requested to help in following up the chemical investigations and controlling the quality. UNIDO was also asked to investigate the possibility of training some of the Libyan personnel in cement companies which produce SRC in Europe. These personnel would have to be trained in kiln operation and quality control for SRC production.

LCC contracted with a transport company for delivery of Galmoya iron ore and Gialo sand, the additional components necessary for SRC production.

The co-ordinator and the engineers studied the modifications required to feed the four raw-material components to the raw mill. The modifications accepted by all the parties as necessary can be briefly summarized as follows:

(a) Modifications have to be carried out to enable crusher I to crush Galmoya iron ore and to transport it from the raw-material stores (area situated between the clinker store and the raw-material mill buildings) to the hopper of the bucket elevator erected outside the no. I crusher building;

(b) The bucket elevator has to be checked and serviced before receiving the iron ore;

(c) Modification and checking of the balances for weighing the raw materials, limestone, sand, marl and iron ore has to be carried out.

After much discussion, it was decided to send two responsible persons, representing the kiln and the laboratory and quality-control departments, with the co-ordinator to Poland so that he could show them the process of producing sulphate-resisting cement in one or more of the cement plants producing this type of cement. This would coincide with the visit of the LCC delegation to Poland for the next interview meeting to be held there in the second half of 1982.

The co-ordinator prepared a special programme with the Polish authorities to visit two cement plants producing SRC. During the visit of the LCC delegation, the co-ordinator tried to explain and demonstrate all the processes to be carried out in producing SRC, starting with the raw-material preparation (proportioning, preblending, prehomogenization, burning etc.). The co-ordinator concentrated particularly on the processes and problems of raw-material preparation and burning since this is fundamental to the success of SRC production.

LCC started up production of SRC at the beginning of 1983. The Secretary of Heavy Industries attended the opening ceremony. During the first period of production, the co-ordinator was required to help in solving some problems. However, in the end, sulphate-resisting cement was successfully produced according to BS 4027, a source of great satisfaction to all who had been concerned with this project. This is the first production of SRC in the Libyan Arab Jamahiriya.

Annex I

COMPUTERIZED RAW MIXES: GROUP A

(Percentage)

Selected values

Raw materials used

	From	To	% increase per step	Chemical analysis					Designation	Source
				CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI		
C ₂ S	40.0	46.0	2.00	51.86	2.23	.58	.35	42.90	Limestone (X ₁)	Hawari quarry
C ₃ A	0.0	3.5	.10	8.86	77.11	2.75	1.02	8.15	Sand (X ₂)	Gialo area
C ₄ AF	10.0	15.0	1.00	1.12	6.12	10.38	62.50	9.24	Iron ore (X ₃)	Galmoya area
				26.32	33.31	8.50	3.60	24.85	Marl (X ₄)	Hawari quarry

Raw mix no.	LSF (1)	SN (2)	AN (3)	HM (4)	C ₂ S (5)	C ₃ A (6)	C ₄ AF (7)	CaO (8)	SiO ₂ (9)	Al ₂ O ₃ (10)	Fe ₂ O ₃ (11)	LOI (12)	X ₁ (13)	X ₂ (14)	X ₃ (15)	X ₄ (16)	
1	81.01	4.96	.64	2.00	40.00	46.42	.00	10.00	41.81	17.36	1.36	2.14	35.00	76.55	19.52	2.59	1.34
2	81.31	4.95	.64	1.99	40.00	45.35	.00	11.00	41.68	17.13	1.50	2.35	34.96	75.62	18.50	2.86	3.02
3	81.62	4.02	.64	1.97	40.00	44.29	.00	12.00	41.56	16.90	1.64	2.57	34.92	74.69	17.48	3.13	4.70
4	81.94	3.66	.64	1.95	40.00	43.22	.00	13.00	41.43	16.67	1.78	2.78	34.89	73.76	16.45	3.40	6.38
5	82.24	3.35	.64	1.93	40.00	42.15	.00	14.00	41.30	16.43	1.91	3.00	34.85	72.83	15.43	3.67	8.07
6	82.54	3.08	.64	1.92	40.00	41.08	.00	15.00	41.17	16.20	2.05	3.21	34.81	71.90	14.40	3.94	9.75
7	81.04	4.92	.65	2.00	40.00	46.32	.10	10.00	41.80	17.34	1.39	2.14	35.01	76.38	19.33	2.57	1.72
8	81.36	4.91	.65	1.99	40.00	45.25	.10	11.00	41.68	17.11	1.53	2.35	34.97	75.45	18.31	2.84	3.40
9	81.67	3.99	.65	1.97	40.00	44.18	.10	12.00	41.55	16.87	1.66	2.57	34.93	74.52	17.29	3.11	5.08
10	81.99	3.63	.65	1.95	40.00	43.11	.10	13.00	41.42	16.64	1.80	2.78	34.89	73.59	16.26	3.38	6.76
11	82.29	3.32	.65	1.93	40.00	42.05	.10	14.00	41.30	16.41	1.94	3.00	34.85	72.66	15.24	3.65	8.45
12	82.61	3.06	.65	1.92	40.00	40.98	.10	15.00	41.17	16.18	2.08	3.21	34.81	71.73	14.21	3.92	10.14
13	81.11	4.88	.66	2.00	40.00	46.21	.20	10.00	41.80	17.31	1.41	2.14	35.01	76.20	19.14	2.56	2.10
14	81.41	4.38	.66	1.99	40.00	45.14	.20	11.00	41.67	17.08	1.55	2.35	34.97	75.28	18.12	2.83	3.78
15	81.72	3.94	.66	1.97	40.00	44.08	.20	12.00	41.54	16.85	1.69	2.57	34.93	74.35	17.09	3.10	5.46
16	82.03	3.61	.66	1.95	40.00	43.01	.20	13.00	41.42	16.62	1.82	2.78	34.89	73.42	16.07	3.36	7.15
17	82.35	3.30	.65	1.93	40.00	41.94	.20	14.00	41.29	16.38	1.96	3.00	34.85	72.48	15.05	3.63	8.83
18	82.67	3.04	.65	1.92	40.00	40.87	.20	15.00	41.16	16.15	2.10	3.21	34.81	71.55	14.02	3.91	10.52
19	81.16	4.84	.67	2.00	40.00	46.10	.30	10.00	41.79	17.29	1.44	2.14	35.01	76.03	18.95	2.54	2.49
20	81.47	4.35	.67	1.99	40.00	45.04	.30	11.00	41.66	17.06	1.57	2.35	34.97	75.10	17.92	2.81	4.17
21	81.77	3.93	.67	1.97	40.00	43.97	.30	12.00	41.54	16.82	1.71	2.57	34.93	74.17	16.90	3.08	5.85
22	82.09	3.58	.66	1.95	40.00	42.90	.30	13.00	41.41	16.59	1.85	2.78	34.90	73.24	15.88	3.35	7.53

LSF	SH	AH	MH	GS	CS	GA	CAF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Sand	Iron O.	Mud
33 02.44	3.26	.66	1.93	40.00	41.84	30.14	60	41.24	16.36	1.99	3.00	34.86	72.31	14.86	3.62	9.22
34 02.79	3.02	.66	1.92	40.00	40.77	30.15	60	41.16	16.13	1.12	3.21	34.82	71.38	13.83	3.89	10.91
35 01.22	4.80	.68	2.00	40.00	46.00	40.10	60	41.78	17.24	1.46	2.14	35.02	75.86	18.75	2.52	2.87
36 01.59	4.31	.68	1.99	40.00	44.93	40.11	60	41.66	17.03	1.40	2.35	34.98	74.93	17.73	2.79	4.55
37 01.89	3.91	.68	1.97	40.00	43.86	40.12	60	41.53	16.80	1.74	2.57	34.94	74.00	16.71	3.06	6.23
38 02.14	3.56	.67	1.95	40.00	42.80	40.13	60	41.40	16.57	1.87	2.78	34.90	73.07	15.69	3.33	7.92
39 02.46	3.26	.67	1.93	40.00	41.73	40.14	60	41.28	16.33	2.01	3.00	34.86	72.14	14.66	3.60	9.60
30 02.78	3.00	.67	1.92	40.00	40.66	40.15	60	41.15	16.10	2.15	3.21	34.82	71.20	13.64	3.87	11.29
31 01.27	4.74	.70	2.00	40.00	45.89	50.10	60	41.78	17.24	1.49	2.14	35.02	75.48	18.86	2.50	3.25
32 01.57	4.28	.69	1.99	40.00	44.83	50.11	60	41.65	17.01	1.62	2.35	34.98	74.75	17.54	2.77	4.93
33 01.88	3.88	.69	1.97	40.00	43.76	50.12	60	41.52	16.77	1.76	2.57	34.94	73.82	16.52	3.04	6.62
34 02.19	3.54	.68	1.95	40.00	42.69	50.13	60	41.40	16.54	1.90	2.78	34.90	72.89	15.50	3.31	8.30
35 02.51	3.24	.68	1.93	40.00	41.62	50.14	60	41.27	16.31	2.04	3.00	34.86	71.96	14.47	3.58	9.99
36 02.83	2.98	.68	1.92	40.00	40.56	50.15	60	41.14	16.08	2.17	3.21	34.82	71.03	13.45	3.85	11.68
37 01.33	4.72	.71	2.00	40.00	45.79	60.10	60	41.77	17.21	1.51	2.14	35.02	75.51	18.37	2.48	3.64
38 01.64	4.25	.70	1.99	40.00	44.72	60.11	60	41.64	16.98	1.65	2.35	34.98	74.58	17.35	2.75	5.32
39 01.94	3.85	.70	1.97	40.00	43.65	60.12	60	41.52	16.75	1.78	2.57	34.95	73.65	16.33	3.02	7.00
40 02.24	3.51	.69	1.95	40.00	42.59	60.13	60	41.39	16.52	1.92	2.78	34.91	72.72	15.30	3.29	8.68
41 02.54	3.22	.69	1.93	40.00	41.52	60.14	60	41.26	16.28	2.06	3.00	34.87	71.79	14.28	3.56	10.37
42 02.84	2.97	.68	1.92	40.00	40.45	60.15	60	41.14	16.05	2.20	3.21	34.83	70.85	13.25	3.83	12.06
43 01.37	4.64	.72	2.00	40.00	45.68	70.10	60	41.76	17.19	1.53	2.14	35.03	75.33	18.18	2.47	4.70
44 01.68	4.22	.71	1.97	40.00	44.61	70.11	60	41.64	16.96	1.67	2.35	34.99	74.41	17.16	2.73	6.38
45 01.98	3.82	.71	1.95	40.00	43.55	70.12	60	41.51	16.72	1.81	2.57	34.95	73.48	16.14	3.00	7.96
46 02.30	3.49	.70	1.94	40.00	42.48	70.13	60	41.38	16.49	1.95	2.78	34.91	72.54	15.11	3.27	9.64
47 02.60	3.20	.70	1.93	40.00	41.41	70.14	60	41.26	16.26	2.08	3.00	34.87	71.61	14.09	3.54	11.32
48 02.94	2.95	.69	1.92	40.00	40.35	70.15	60	41.13	16.03	2.22	3.21	34.83	70.68	13.06	3.81	12.94
49 01.41	4.45	.73	2.00	40.00	45.58	80.10	60	41.76	17.16	1.56	2.13	35.03	75.16	17.99	2.45	4.40
50 01.71	4.18	.72	1.97	40.00	44.51	80.11	60	41.63	16.93	1.70	2.35	34.99	74.23	16.97	2.72	6.08
51 02.01	3.80	.71	1.95	40.00	43.44	80.12	60	41.50	16.70	1.83	2.56	34.95	73.30	15.94	2.99	7.77
52 02.34	3.47	.71	1.94	40.00	42.37	80.13	60	41.38	16.47	1.97	2.78	34.91	72.37	14.92	3.26	9.45
53 02.64	3.18	.70	1.93	40.00	41.31	80.14	60	41.25	16.24	2.11	3.00	34.87	71.44	13.90	3.53	11.14
54 03.00	2.93	.70	1.92	40.00	40.24	80.15	60	41.12	16.00	2.25	3.21	34.83	70.51	12.87	3.80	12.83
55 01.44	4.41	.74	2.00	40.00	45.47	90.10	60	41.75	17.14	1.58	2.13	35.03	74.99	17.80	2.43	4.79
56 01.74	4.15	.73	1.98	40.00	44.40	90.11	60	41.63	16.91	1.72	2.35	34.99	74.06	16.78	2.70	6.47
57 02.04	3.77	.72	1.97	40.00	43.34	90.12	60	41.50	16.68	1.86	2.56	34.96	73.13	15.75	2.97	8.15
58 02.34	3.44	.72	1.95	40.00	42.27	90.13	60	41.37	16.44	2.00	2.78	34.92	72.20	14.73	3.24	9.84
59 02.64	3.16	.71	1.93	40.00	41.20	90.14	60	41.24	16.21	2.13	3.00	34.88	71.26	13.71	3.51	11.52
60 03.04	2.91	.71	1.92	40.00	40.13	90.15	60	41.12	15.98	2.27	3.21	34.84	70.33	12.68	3.78	13.21

	LSE	SH	AH	HM	GJS	G5	GA	CAF	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Iron Ore	Hard
1	01.51	4.57	.75	2.00	40.00	45.37	1.00	10.00	41.75	17.11	1.61	2.35	35.04	74.81	17.61	2.41	5.17
2	01.51	4.12	.74	1.98	40.00	44.30	1.00	11.00	41.62	16.88	1.75	2.35	35.00	73.88	16.58	2.48	4.85
3	02.14	3.74	.73	1.97	40.00	43.23	1.00	12.00	41.49	16.45	1.88	2.56	34.96	72.95	15.56	2.95	4.53
4	02.44	3.42	.73	1.95	40.00	42.16	1.00	13.00	41.37	16.47	2.02	2.78	34.92	72.02	14.54	3.22	4.22
5	02.79	3.14	.72	1.93	40.00	41.10	1.00	14.00	41.24	16.15	2.16	3.00	34.88	71.09	13.51	3.49	3.91
6	03.11	2.90	.71	1.92	40.00	40.03	1.00	15.00	41.11	15.95	2.30	3.21	34.84	70.16	12.49	3.76	3.60
7	01.51	4.09	.76	2.00	40.00	45.26	1.10	10.00	41.74	17.09	1.63	2.33	35.04	74.64	17.41	2.39	5.55
8	01.80	4.09	.75	1.98	40.00	44.19	1.10	11.00	41.61	16.86	1.77	2.35	35.00	73.71	16.39	2.66	5.24
9	02.20	3.72	.74	1.97	40.00	43.12	1.10	12.00	41.49	16.43	1.91	2.56	34.96	72.78	15.37	2.93	4.92
90	02.51	3.40	.74	1.95	40.00	42.06	1.10	13.00	41.36	16.39	2.04	2.78	34.92	71.85	14.35	3.20	4.60
1	02.80	3.12	.73	1.93	40.00	40.99	1.10	14.00	41.23	16.16	2.18	3.00	34.88	70.92	13.32	3.47	4.29
2	03.11	2.88	.72	1.92	40.00	39.92	1.10	15.00	41.10	15.93	2.32	3.21	34.84	69.98	12.30	3.74	3.98
3	01.60	4.50	.76	2.00	40.00	45.15	1.20	10.00	41.73	17.04	1.66	2.13	35.04	74.46	17.22	2.38	5.94
4	01.90	4.06	.76	1.98	40.00	44.09	1.20	11.00	41.61	16.83	1.79	2.35	35.00	73.54	16.20	2.64	5.62
5	02.20	3.69	.75	1.97	40.00	43.02	1.20	12.00	41.48	16.60	1.93	2.56	34.97	72.61	15.18	2.91	5.30
6	02.51	3.38	.74	1.95	40.00	41.95	1.20	13.00	41.35	16.37	2.07	2.78	34.93	71.67	14.16	3.18	5.00
7	02.90	3.10	.74	1.93	40.00	40.88	1.20	14.00	41.23	16.14	2.21	3.00	34.89	70.74	13.13	3.45	4.67
8	03.22	2.86	.73	1.92	40.00	39.82	1.20	15.00	41.10	15.90	2.35	3.21	34.85	69.81	12.10	3.72	4.36
9	01.60	4.47	.79	2.00	40.00	45.05	1.30	10.00	41.73	17.04	1.60	2.13	35.05	74.29	17.03	2.36	6.32
80	02.00	4.03	.77	1.98	40.00	43.98	1.30	11.00	41.60	16.81	1.82	2.35	35.01	73.36	16.01	2.63	6.00
1	02.31	3.67	.76	1.97	40.00	42.91	1.30	12.00	41.47	16.58	1.96	2.56	34.97	72.43	14.99	2.89	5.68
2	02.64	3.35	.75	1.95	40.00	41.85	1.30	13.00	41.35	16.34	2.09	2.78	34.93	71.50	13.96	3.16	5.37
3	02.96	3.08	.75	1.93	40.00	40.78	1.30	14.00	41.22	16.11	2.23	3.00	34.89	70.57	12.94	3.43	5.06
4	03.28	2.85	.74	1.91	40.00	39.71	1.30	15.00	41.09	15.88	2.37	3.21	34.85	69.64	11.91	3.70	4.75
5	01.70	4.43	.80	2.00	40.00	44.94	1.40	10.00	41.72	17.01	1.71	2.13	35.05	74.12	16.84	2.34	6.70
6	02.06	4.04	.78	1.98	40.00	43.87	1.40	11.00	41.59	16.78	1.84	2.35	35.01	73.19	15.82	2.61	6.39
7	02.36	3.66	.77	1.97	40.00	42.81	1.40	12.00	41.47	16.55	1.98	2.56	34.97	72.26	14.80	2.88	6.07
8	02.66	3.33	.76	1.95	40.00	41.74	1.40	13.00	41.34	16.32	2.12	2.78	34.93	71.33	13.77	3.15	5.75
9	03.01	3.06	.75	1.93	40.00	40.67	1.40	14.00	41.21	16.09	2.26	3.00	34.89	70.39	12.75	3.42	5.44
90	03.33	2.83	.75	1.91	40.00	39.61	1.40	15.00	41.08	15.85	2.39	3.21	34.85	69.46	11.72	3.69	5.13
1	01.70	4.40	.81	2.00	40.00	44.84	1.50	10.00	41.71	16.99	1.73	2.13	35.05	73.94	16.45	2.32	7.09
2	02.10	3.97	.79	1.98	40.00	43.77	1.50	11.00	41.59	16.76	1.87	2.35	35.02	73.01	15.43	2.59	6.77
3	02.42	3.62	.78	1.97	40.00	42.70	1.50	12.00	41.46	16.53	2.00	2.56	34.98	72.08	14.41	2.86	6.45
4	02.74	3.31	.77	1.95	40.00	41.64	1.50	13.00	41.33	16.29	2.14	2.78	34.94	71.15	13.50	3.13	6.14
5	03.04	3.04	.76	1.93	40.00	40.57	1.50	14.00	41.21	16.06	2.28	2.99	34.90	70.22	12.56	3.40	5.83
6	03.39	2.81	.75	1.91	40.00	39.50	1.50	15.00	41.08	15.83	2.42	3.21	34.86	69.29	11.53	3.67	5.52
7	01.60	4.36	.82	2.00	40.00	44.73	1.60	10.00	41.71	16.94	1.75	2.13	35.06	73.77	16.46	2.30	7.47
8	02.10	3.95	.81	1.98	40.00	43.66	1.60	11.00	41.58	16.73	1.89	2.35	35.02	72.84	15.44	2.57	7.15

LSF	SN	NH	NH	G _S	G _S	G _A	G _{MF}	CaO	S.O ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Band	Iron ore	Hard
902.47	3.59	.79	1.97	40.00	42.40	1.40	12.00	41.45	16.50	2.03	2.56	34.98	71.91	14.91	2.84	10.84
902.79	3.29	.78	1.95	40.00	41.53	1.40	13.00	41.33	16.27	2.17	2.78	34.94	70.98	13.39	3.11	12.52
103.19	3.03	.77	1.93	40.00	40.94	1.40	14.00	41.20	16.04	2.30	2.99	34.90	70.05	12.34	3.38	14.21
203.44	2.80	.76	1.91	40.00	39.39	1.40	15.00	41.07	15.80	2.44	3.21	34.86	69.11	11.34	3.65	15.90
301.96	4.33	.83	2.00	40.00	44.43	1.70	10.00	41.70	16.94	1.70	2.13	35.06	73.60	16.27	2.28	7.85
402.21	3.92	.82	1.98	40.00	43.54	1.70	11.00	41.57	16.71	1.92	2.35	35.02	72.67	15.25	2.55	9.53
502.59	3.57	.80	1.96	40.00	42.49	1.70	12.00	41.45	16.48	2.05	2.56	34.98	71.79	14.22	2.82	11.22
602.84	3.27	.79	1.95	40.00	41.42	1.70	13.00	41.32	16.24	2.19	2.78	34.94	70.81	13.20	3.09	12.91
703.17	3.01	.78	1.93	40.00	40.94	1.70	14.00	41.19	16.01	2.33	2.99	34.90	69.87	12.17	3.36	14.59
803.54	2.78	.77	1.91	40.00	39.29	1.70	15.00	41.07	15.78	2.47	3.21	34.87	68.94	11.15	3.63	16.28
901.94	4.30	.85	2.00	40.00	44.52	1.80	10.00	41.69	16.92	1.80	2.13	35.03	73.49	14.08	2.27	8.24
1002.26	3.89	.83	1.98	40.00	43.45	1.80	11.00	41.57	16.68	1.94	2.35	35.03	72.49	13.05	2.53	9.92
102.58	3.54	.81	1.96	40.00	42.39	1.80	12.00	41.44	16.45	2.08	2.56	34.99	71.56	14.03	2.80	11.60
102.90	3.25	.80	1.95	40.00	41.32	1.80	13.00	41.31	16.22	2.22	2.78	34.95	70.63	13.01	3.07	13.29
203.21	2.99	.79	1.93	40.00	40.25	1.80	14.00	41.19	15.99	2.35	2.99	34.91	69.70	11.98	3.34	14.98
303.51	2.76	.78	1.91	40.00	39.18	1.80	15.00	41.06	15.75	2.49	3.21	34.87	68.76	10.96	3.61	16.67
402.76	3.06	.84	1.98	40.00	43.35	1.90	10.00	41.64	16.86	1.83	2.13	35.07	73.25	15.88	2.25	8.62
502.37	3.52	.82	1.96	40.00	42.28	1.90	11.00	41.56	16.64	1.97	2.35	35.03	72.32	14.86	2.52	10.30
602.67	3.23	.81	1.95	40.00	41.21	1.90	12.00	41.43	16.43	2.10	2.56	34.99	71.39	13.84	2.79	11.98
702.94	3.23	.81	1.95	40.00	41.15	1.90	13.00	41.31	16.19	2.24	2.78	34.95	70.46	12.82	3.05	13.67
803.24	2.97	.79	1.93	40.00	40.15	1.90	14.00	41.18	15.94	2.38	2.99	34.91	69.52	11.79	3.32	15.36
902.41	2.75	.78	1.91	40.00	39.08	1.90	15.00	41.05	15.73	2.52	3.21	34.87	68.59	10.76	3.59	17.05
1002.05	3.23	.87	2.00	40.00	44.31	2.00	10.00	41.68	16.87	1.85	2.13	35.07	73.07	15.49	2.23	9.00
202.37	3.83	.85	1.98	40.00	43.24	2.00	11.00	41.55	16.63	1.99	2.35	35.03	72.15	14.47	2.50	10.68
302.69	3.50	.82	1.96	40.00	42.17	2.00	12.00	41.43	16.40	2.13	2.56	34.99	71.22	13.45	2.77	12.37
403.01	3.21	.80	1.95	40.00	41.11	2.00	13.00	41.30	16.17	2.26	2.78	34.95	70.28	12.42	3.04	14.06
503.34	2.95	.80	1.93	40.00	40.04	2.00	14.00	41.17	15.94	2.40	2.99	34.91	69.35	11.40	3.31	15.74
603.67	2.73	.79	1.91	40.00	38.97	2.00	15.00	41.05	15.70	2.54	3.21	34.88	68.42	10.37	3.58	17.43
702.11	3.20	.80	1.98	40.00	44.20	2.10	10.00	41.67	16.89	1.88	2.13	35.07	72.90	15.50	2.21	9.38
802.41	3.81	.84	1.98	40.00	43.14	2.10	11.00	41.55	16.61	2.01	2.35	35.04	71.97	14.48	2.48	11.07
902.74	3.47	.84	1.96	40.00	42.07	2.10	12.00	41.42	16.38	2.15	2.56	35.00	71.04	13.46	2.75	12.75

LSF	SH	AH	NH	S _S	S _S	S _A	S _{AF}	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	San ₂	IronOre	Marl
130	183.07	.82	1.95	40.00	41.00	2.10	13.00	41.27	16.14	2.27	2.78	34.96	70.11	12.43	3.02	14.44
1	183.39	.81	1.93	40.00	39.93	2.10	14.00	41.17	15.91	2.79	2.99	34.92	69.18	11.41	3.29	16.13
2	183.73	.80	1.91	40.00	38.87	2.10	15.00	41.07	15.68	2.87	3.21	34.88	68.24	10.38	3.56	17.82
3	182.14	.89	2.00	40.00	44.10	2.20	10.00	41.67	16.82	1.90	2.13	35.08	72.73	15.31	2.19	19.77
4	182.44	.87	1.98	40.00	43.03	2.20	11.00	41.57	16.58	2.04	2.35	35.04	71.80	14.29	2.46	11.45
5	182.80	.85	1.96	40.00	41.96	2.20	12.00	41.42	16.35	2.18	2.56	35.00	70.87	13.27	2.73	13.13
6	183.17	.83	1.95	40.00	40.90	2.20	13.00	41.27	16.12	2.31	2.78	34.96	69.94	12.24	3.00	14.82
7	183.45	.82	1.93	40.00	39.83	2.20	14.00	41.16	15.89	2.45	2.99	34.92	69.00	11.22	3.27	16.51
8	183.78	.81	1.91	40.00	38.74	2.20	15.00	41.03	15.65	2.59	3.21	34.88	68.07	10.19	3.54	18.20
9	182.29	.90	2.00	40.00	43.99	2.30	10.00	41.66	16.79	1.93	2.13	35.08	72.55	15.12	2.18	10.15
140	182.53	.88	1.98	40.00	42.92	2.30	11.00	41.54	16.54	2.06	2.35	35.04	71.62	14.10	2.44	11.83
1	182.85	.86	1.96	40.00	41.86	2.30	12.00	41.41	16.33	2.20	2.56	35.00	70.69	13.08	2.71	13.52
2	183.18	.84	1.95	40.00	40.79	2.30	13.00	41.28	16.10	2.34	2.78	34.96	69.76	12.05	2.98	15.20
3	183.51	.83	1.93	40.00	39.72	2.30	14.00	41.15	15.86	2.48	2.99	34.92	68.83	11.03	3.25	16.89
4	183.84	.81	1.91	40.00	38.64	2.30	15.00	41.03	15.63	2.61	3.21	34.89	67.90	10.00	3.52	18.58
5	182.27	.91	2.00	40.00	43.89	2.40	10.00	41.66	16.77	1.95	2.13	35.08	72.38	14.93	2.16	10.53
6	182.59	.89	1.98	40.00	42.82	2.40	11.00	41.53	16.53	2.09	2.35	35.05	71.45	13.91	2.43	12.22
7	182.91	.87	1.96	40.00	41.75	2.40	12.00	41.40	16.30	2.22	2.56	35.01	70.52	12.88	2.69	13.90
8	183.23	.85	1.95	40.00	40.68	2.40	13.00	41.28	16.07	2.36	2.78	34.97	69.59	11.86	2.96	15.59
9	183.56	.84	1.93	40.00	39.62	2.40	14.00	41.15	15.84	2.50	2.99	34.93	68.66	10.83	3.23	17.28
150	183.90	.82	1.91	40.00	38.55	2.40	15.00	41.02	15.61	2.64	3.21	34.89	67.72	9.81	3.50	18.97
1	182.32	.93	2.00	40.00	43.78	2.50	10.00	41.65	16.74	1.97	2.13	35.08	72.21	14.74	2.14	10.92
2	182.64	.90	1.98	40.00	42.71	2.50	11.00	41.52	16.51	2.11	2.35	35.05	71.28	13.72	2.41	12.60
3	182.96	.88	1.96	40.00	41.65	2.50	12.00	41.40	16.28	2.25	2.56	35.01	70.35	12.69	2.68	14.28
4	183.29	.86	1.95	40.00	40.58	2.50	13.00	41.27	16.05	2.39	2.78	34.97	69.41	11.67	2.95	15.97
5	183.61	.84	1.93	40.00	39.51	2.50	14.00	41.14	15.81	2.52	2.99	34.93	68.48	10.64	3.22	17.66
6	183.95	.83	1.91	40.00	38.44	2.50	15.00	41.01	15.58	2.66	3.21	34.89	67.55	9.62	3.48	19.35
7	182.38	.94	2.00	40.00	43.68	2.60	10.00	41.64	16.72	2.00	2.13	35.09	72.03	14.55	2.12	11.30
8	182.60	.91	1.98	40.00	42.61	2.60	11.00	41.52	16.49	2.14	2.35	35.05	71.10	13.53	2.39	12.98
9	183.02	.89	1.96	40.00	41.54	2.60	12.00	41.39	16.25	2.27	2.56	35.01	70.17	12.50	2.66	14.67
160	183.34	.87	1.95	40.00	40.47	2.60	13.00	41.26	16.02	2.41	2.78	34.97	69.24	11.48	2.93	16.35
1	183.67	.85	1.93	40.00	39.41	2.60	14.00	41.14	15.79	2.55	2.99	34.94	68.31	10.45	3.20	18.04

	LSF	SH	AH	NH	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO
2	84,01	2,64	,84	1,91	40,00	38,34	2,60	15,00	41,01
3	82,43	4,02	,95	2,00	40,00	43,57	2,70	10,00	41,64
4	82,75	3,65	,92	1,98	40,00	42,50	2,70	11,00	41,51
5	83,07	3,34	,90	1,96	40,00	41,44	2,70	12,00	41,38
6	83,40	3,07	,88	1,95	40,00	40,37	2,70	13,00	41,26
7	83,73	2,83	,86	1,93	40,00	39,30	2,70	14,00	41,13
8	84,07	2,62	,85	1,91	40,00	38,23	2,70	15,00	41,00
9	82,48	3,99	,96	2,00	40,00	43,46	2,80	10,00	41,63
170	82,80	3,63	,93	1,98	40,00	42,40	2,80	11,00	41,50
1	83,13	3,32	,91	1,96	40,00	41,33	2,80	12,00	41,38
2	83,45	3,05	,89	1,94	40,00	40,26	2,80	13,00	41,25
3	83,79	2,82	,87	1,93	40,00	39,19	2,80	14,00	41,12
4	84,13	2,61	,85	1,91	40,00	38,13	2,80	15,00	41,00
5	82,54	3,96	,97	2,00	40,00	43,26	2,90	10,00	41,62
6	82,86	3,60	,94	1,98	40,00	42,29	2,90	11,00	41,50
7	83,18	3,30	,92	1,96	40,00	41,22	2,90	12,00	41,37
8	83,51	3,03	,89	1,94	40,00	40,16	2,90	13,00	41,24
9	83,84	2,80	,88	1,93	40,00	39,09	2,90	14,00	41,12
180	84,18	2,59	,86	1,91	40,00	38,02	2,90	15,00	40,99
1	82,59	3,93	,98	2,00	40,00	43,25	3,00	10,00	41,62
2	82,91	3,58	,95	1,98	40,00	42,19	3,00	11,00	41,49
3	83,24	3,27	,93	1,96	40,00	41,12	3,00	12,00	41,36
4	83,57	3,01	,90	1,94	40,00	40,05	3,00	13,00	41,24
5	83,90	2,78	,88	1,93	40,00	38,98	3,00	14,00	41,11
6	84,24	2,58	,87	1,91	40,00	37,92	3,00	15,00	40,98
7	82,65	3,90	,99	2,00	40,00	43,15	3,10	10,00	41,61
8	82,97	3,55	,96	1,98	40,00	42,08	3,10	11,00	41,48
9	83,29	3,25	,94	1,96	40,00	41,01	3,10	12,00	41,36
190	83,62	2,99	,91	1,94	40,00	39,95	3,10	13,00	41,23
1	83,94	2,77	,89	1,93	40,00	38,88	3,10	14,00	41,10
2	84,30	2,56	,88	1,91	40,00	37,81	3,10	15,00	40,98

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Sand	Iron Ore	Marl
15.56	2.49	3.21	34.90	67.37	9.42	3.47	19.74
16.69	2.02	2.13	35.09	71.86	14.36	2.10	11.68
16.46	2.16	2.35	35.06	70.93	13.33	2.37	13.36
16.23	2.30	2.56	35.02	70.00	12.31	2.44	15.05
16.00	2.44	2.78	34.98	69.07	11.29	2.91	16.74
15.76	2.57	2.99	34.94	68.13	10.26	3.18	18.43
15.53	2.71	3.21	34.90	67.20	9.23	3.45	20.12
16.67	2.05	2.13	35.10	71.69	14.17	2.08	12.06
16.44	2.18	2.35	35.06	70.76	13.14	2.35	13.75
16.20	2.32	2.56	35.02	69.83	12.12	2.62	15.43
15.97	2.46	2.78	34.98	68.89	11.09	2.89	17.12
15.74	2.60	2.99	34.94	67.96	10.07	3.16	18.81
15.51	2.74	3.21	34.90	67.03	9.04	3.43	20.50
16.64	2.07	2.13	35.10	71.51	13.97	2.07	12.45
16.41	2.21	2.35	35.06	70.58	12.95	2.34	14.13
16.18	2.35	2.56	35.02	69.65	11.93	2.60	15.82
15.95	2.48	2.78	34.98	68.72	10.90	2.87	17.50
15.71	2.62	2.99	34.95	67.79	9.88	3.14	19.19
15.48	2.76	3.21	34.91	66.85	8.85	3.41	20.89
16.62	2.10	2.13	35.11	71.34	13.78	2.05	12.83
16.39	2.23	2.35	35.07	70.41	12.76	2.32	14.51
16.15	2.37	2.56	35.03	69.48	11.74	2.59	16.20
15.92	2.51	2.78	34.99	68.55	10.71	2.85	17.89
15.69	2.65	2.99	34.95	67.61	9.69	3.12	19.58
15.46	2.78	3.21	34.91	66.68	8.66	3.39	21.27
16.59	2.12	2.13	35.11	71.17	13.59	2.03	13.21
16.36	2.26	2.35	35.07	70.24	12.57	2.30	14.90
16.13	2.40	2.56	35.03	69.30	11.55	2.57	16.58
15.90	2.53	2.78	34.99	68.37	10.52	2.84	18.27
15.66	2.67	2.99	34.95	67.44	9.50	3.11	19.96
15.43	2.81	3.21	34.91	66.50	8.47	3.38	21.65

	LSF	SH	AM	HH	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	C ₂ O
3	82,70	3,87	1,01	2,00	40,00	43,04	3,20	10,00	41,40
4	83,09	3,53	,97	1,98	40,00	41,97	3,20	11,00	41,48
5	83,35	3,23	,94	1,96	40,00	40,91	3,20	12,00	41,35
6	83,60	2,90	,92	1,94	40,00	39,84	3,20	13,00	41,22
7	84,01	2,75	,90	1,93	40,00	38,77	3,20	14,00	41,10
8	84,34	2,55	,88	1,91	40,00	37,70	3,20	15,00	40,97
9	82,75	3,85	1,02	2,00	40,00	42,94	3,30	10,00	41,60
200	83,09	3,51	,98	1,98	40,00	41,87	3,30	11,00	41,47
1	83,40	3,21	,95	1,96	40,00	40,80	3,30	12,00	41,34
2	83,73	2,96	,93	1,94	40,00	39,73	3,30	13,00	41,22
3	84,07	2,73	,91	1,93	40,00	38,67	3,30	14,00	41,09
4	84,41	2,54	,89	1,91	40,00	37,60	3,30	15,00	40,96
5	82,81	3,82	1,03	2,00	40,00	42,83	3,40	10,00	41,59
6	83,13	3,48	,99	1,98	40,00	41,76	3,40	11,00	41,47
7	83,46	3,19	,96	1,96	40,00	40,70	3,40	12,00	41,34
8	83,79	2,94	,94	1,94	40,00	39,63	3,40	13,00	41,21
9	84,13	2,72	,92	1,93	40,00	38,56	3,40	14,00	41,08
210	84,47	2,52	,90	1,91	40,00	37,49	3,40	15,00	40,96
1	82,86	3,79	1,04	2,00	40,00	42,72	3,50	10,00	41,59
2	83,19	3,44	1,00	1,98	40,00	41,66	3,50	11,00	41,46
3	83,51	3,17	,97	1,96	40,00	40,59	3,50	12,00	41,33
4	83,85	2,92	,95	1,94	40,00	39,52	3,50	13,00	41,20
5	84,18	2,70	,93	1,93	40,00	38,46	3,50	14,00	41,08
6	84,53	2,51	,91	1,91	40,00	37,39	3,50	15,00	40,95
7	81,72	4,93	,64	2,02	42,00	44,42	,00	10,00	41,88
7	82,03	4,42	,64	2,00	42,00	43,35	,00	11,00	41,76
9	82,34	3,99	,64	1,98	42,00	42,28	,00	12,00	41,63
220	82,64	3,63	,64	1,97	42,00	41,22	,00	13,00	41,50
1	82,94	3,32	,64	1,95	42,00	40,15	,00	14,00	41,37
2	83,31	3,04	,64	1,93	42,00	39,08	,00	15,00	41,25
3	81,77	4,89	,65	2,02	42,00	44,31	,10	10,00	41,88

SiO_2	Al_2O_3	Fe_2O_3	LOI	LS	Sand	Iron Ore	Marl
14,57	2,14	2,13	35,11	70,97	13,40	2,01	13,59
14,34	2,28	2,35	35,07	70,04	12,38	2,28	15,28
14,10	2,42	2,54	35,03	69,13	11,36	2,55	14,96
15,87	2,56	2,78	34,99	68,20	10,33	2,82	18,65
15,64	2,70	2,99	34,96	67,27	9,30	3,09	20,34
15,41	2,83	3,21	34,92	66,33	8,28	3,36	22,03
14,54	2,17	2,13	35,12	70,82	13,21	1,99	13,98
14,31	2,31	2,35	35,08	69,89	12,19	2,26	15,66
14,08	2,44	2,54	35,04	68,96	11,16	2,53	17,35
15,85	2,58	2,78	35,00	68,03	10,14	2,80	19,04
15,61	2,72	2,99	34,96	67,09	9,11	3,07	20,73
15,38	2,86	3,21	34,92	66,16	8,09	3,34	22,42
16,52	2,19	2,13	35,12	70,45	13,02	1,98	14,36
16,29	2,33	2,35	35,08	69,72	12,00	2,24	14,04
14,04	2,47	2,54	35,04	68,78	10,97	2,51	17,73
15,82	2,61	2,78	35,00	67,85	9,95	2,78	19,42
15,59	2,74	2,99	34,96	66,92	8,92	3,05	21,11
15,36	2,88	3,21	34,92	65,98	7,89	3,32	22,80
14,49	2,22	2,13	35,12	70,47	12,83	1,96	14,74
14,24	2,36	2,35	35,08	69,54	11,81	2,23	16,43
14,03	2,49	2,54	35,04	68,61	10,78	2,49	18,11
15,80	2,63	2,78	35,01	67,68	9,76	2,76	19,80
15,57	2,77	2,99	34,97	66,74	8,73	3,03	21,49
15,33	2,91	3,21	34,93	65,81	7,70	3,30	23,18
17,23	1,34	2,13	35,04	76,70	19,33	2,59	1,38
17,00	1,50	2,35	35,02	75,77	18,31	2,86	3,05
14,77	1,64	2,54	34,98	74,85	17,29	3,13	4,73
16,54	1,77	2,78	34,94	73,92	16,27	3,40	6,42
16,31	1,91	2,99	34,91	72,99	15,25	3,67	8,10
16,07	2,05	3,21	34,87	72,05	14,22	3,94	9,79
17,21	1,39	2,13	35,07	76,53	19,14	2,57	1,76

- 43 -

LSF	SH	AH	NH	GS	CS	GA	CAF	CAO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	SAND	Iron Ore	Hard
4 02.04	4.30	.65	2.00	42.00	43.24	.10	11.00	41.75	16.98	1.52	2.35	35.03	75.40	10.12	2.84	3.44
5 02.39	3.96	.65	1.98	42.00	42.18	.10	12.00	41.62	16.75	1.44	2.54	34.99	74.47	17.10	3.11	5.12
6 02.71	3.41	.65	1.97	42.00	41.11	.10	13.00	41.50	16.51	1.40	2.78	34.95	73.74	16.08	3.38	6.80
7 03.04	3.30	.65	1.95	42.00	40.04	.10	14.00	41.37	16.28	1.39	2.99	34.91	72.81	15.05	3.45	8.48
8 03.36	3.04	.65	1.93	42.00	38.98	.10	15.00	41.24	16.05	1.37	3.21	34.87	71.88	14.03	3.42	10.17
9 01.67	4.05	.64	2.02	42.00	44.21	.20	10.00	41.87	17.18	1.55	2.13	35.07	76.35	10.95	2.55	2.14
230 02.10	4.35	.64	1.98	42.00	42.14	.20	11.00	41.74	16.95	1.55	2.35	35.03	75.43	17.93	2.82	3.82
1 02.42	3.94	.64	1.98	42.00	42.07	.20	12.00	41.62	16.72	1.49	2.56	34.99	74.50	16.91	3.09	5.50
2 02.77	3.58	.64	1.97	42.00	41.00	.20	13.00	41.49	16.49	1.48	2.78	34.95	73.57	15.89	3.34	7.18
3 03.09	3.28	.65	1.95	42.00	39.94	.20	14.00	41.36	16.26	1.46	2.99	34.91	72.64	14.86	3.63	8.87
4 03.49	3.02	.65	1.93	42.00	38.87	.20	15.00	41.23	16.02	1.44	3.21	34.87	71.71	13.84	3.90	10.55
5 01.88	4.01	.67	2.02	42.00	44.10	.30	10.00	41.86	17.16	1.54	2.13	35.07	76.18	18.76	2.54	2.53
6 02.10	4.32	.67	2.00	42.00	43.03	.30	11.00	41.74	16.93	1.57	2.35	35.03	75.25	17.74	2.80	4.20
7 02.50	3.91	.67	1.98	42.00	41.97	.30	12.00	41.61	16.70	1.57	2.56	34.99	74.32	16.72	3.07	5.88
8 02.87	3.56	.66	1.97	42.00	40.90	.30	13.00	41.48	16.46	1.55	2.78	34.95	73.39	15.70	3.34	7.57
9 03.14	3.26	.66	1.95	42.00	39.83	.30	14.00	41.36	16.23	1.54	2.99	34.92	72.46	14.67	3.61	9.25
240 03.47	3.00	.66	1.93	42.00	38.76	.30	15.00	41.23	16.00	1.52	3.21	34.88	71.53	13.65	3.88	10.94
1 01.93	4.27	.68	2.02	42.00	44.93	.40	10.00	41.86	17.14	1.46	2.13	35.08	76.01	18.57	2.52	2.91
2 02.24	4.28	.68	2.00	42.00	42.90	.40	11.00	41.73	16.90	1.46	2.35	35.04	75.08	17.58	2.79	4.59
3 02.54	3.88	.68	1.98	42.00	41.84	.40	12.00	41.60	16.67	1.46	2.56	35.00	74.15	16.53	3.06	6.27
4 02.88	3.54	.67	1.97	42.00	40.77	.40	13.00	41.48	16.44	1.47	2.78	34.96	73.22	15.50	3.32	7.95
5 03.26	3.24	.67	1.95	42.00	39.73	.40	14.00	41.35	16.21	1.47	2.99	34.92	72.29	14.48	3.59	9.64
6 03.59	2.98	.67	1.93	42.00	38.66	.40	15.00	41.22	15.97	1.45	3.21	34.88	71.36	13.46	3.86	11.32
7 01.98	4.73	.70	2.02	42.00	43.89	.50	10.00	41.85	17.11	1.48	2.13	35.08	75.83	18.38	2.50	3.29
8 02.30	4.25	.69	1.98	42.00	41.82	.50	11.00	41.72	16.88	1.46	2.35	35.04	74.91	17.36	2.50	4.97
9 02.61	3.85	.69	1.98	42.00	40.75	.50	12.00	41.60	16.65	1.46	2.56	35.00	73.98	16.34	3.04	6.65
250 02.91	3.51	.68	1.97	42.00	40.69	.50	13.00	41.47	16.41	1.46	2.78	34.96	73.05	15.31	3.31	8.33
1 03.24	3.22	.68	1.95	42.00	39.62	.50	14.00	41.34	16.18	1.45	2.99	34.92	72.12	14.29	3.58	10.02
2 03.50	2.96	.68	1.93	42.00	38.55	.50	15.00	41.22	15.95	1.45	3.21	34.88	71.19	13.26	3.85	11.71
3 02.35	4.09	.71	2.02	42.00	43.78	.60	10.00	41.84	17.09	1.45	2.13	35.08	75.66	18.18	2.48	3.67
4 02.64	3.82	.70	2.00	42.00	42.72	.60	11.00	41.72	16.85	1.45	2.35	35.04	74.73	17.16	2.75	5.35
5 02.64	3.82	.70	1.98	42.00	41.65	.60	12.00	41.59	16.62	1.48	2.56	35.00	73.80	16.14	3.02	7.03

LSF	SH	AH	MO	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Sand	Iron Ore	Marl
6	82.94	.69	1.97	42.00	40.58	.60	13.00	41.46	16.39	1.92	2.78	34.97	72.87	15.12	3.29	8.72
7	83.31	.69	1.95	42.00	39.51	.60	14.00	41.34	16.16	2.06	2.99	34.93	71.94	14.10	3.56	10.40
8	83.64	.68	1.93	42.00	38.45	.60	15.00	41.21	15.93	2.20	3.21	34.89	71.01	13.07	3.83	12.09
9	82.09	.72	2.02	42.00	43.68	.70	10.00	41.84	17.06	1.53	2.13	35.09	75.49	17.99	2.46	4.06
26	82.40	.71	2.00	42.00	42.61	.70	11.00	41.71	16.83	1.67	2.35	35.05	74.56	16.97	2.73	5.74
1	82.72	.71	1.98	42.00	41.54	.70	12.00	41.58	16.60	1.81	2.56	35.01	73.63	15.95	3.00	7.42
2	83.04	.70	1.97	42.00	40.48	.70	13.00	41.46	16.37	1.95	2.78	34.97	72.70	14.93	3.27	9.10
3	83.37	.70	1.95	42.00	39.41	.70	14.00	41.33	16.13	2.08	2.99	34.93	71.77	13.91	3.54	10.79
4	83.70	.69	1.93	42.00	38.34	.70	15.00	41.20	15.90	2.22	3.21	34.89	70.84	12.88	3.81	12.47
5	82.14	.73	2.02	42.00	43.57	.80	10.00	41.83	17.04	1.56	2.13	35.09	75.31	17.80	2.44	4.44
6	82.48	.72	2.00	42.00	42.51	.80	11.00	41.70	16.80	1.69	2.35	35.05	74.38	16.78	2.71	6.12
7	82.77	.71	1.98	42.00	41.44	.80	12.00	41.58	16.57	1.83	2.56	35.01	73.46	15.76	2.98	7.80
8	83.09	.71	1.97	42.00	40.37	.80	13.00	41.45	16.34	1.97	2.78	34.97	72.53	14.74	3.25	9.48
9	83.42	.70	1.95	42.00	39.30	.80	14.00	41.32	16.11	2.11	2.99	34.93	71.59	13.71	3.52	11.17
27	82.75	.74	1.93	42.00	38.24	.90	15.00	41.20	15.88	2.25	3.21	34.89	70.66	12.69	3.79	12.86
1	82.51	.73	2.02	42.00	43.47	.90	10.00	41.82	17.01	1.58	2.13	35.09	75.14	17.61	2.43	4.82
2	82.83	.72	2.00	42.00	42.40	.90	11.00	41.70	16.78	1.72	2.35	35.05	74.21	16.59	2.70	6.50
3	83.15	.72	1.98	42.00	41.33	.90	12.00	41.57	16.55	1.86	2.56	35.01	73.28	15.57	2.96	8.18
4	83.48	.71	1.97	42.00	40.27	.90	13.00	41.44	16.32	1.99	2.78	34.98	72.35	14.55	3.23	9.87
5	83.81	.71	1.95	42.00	39.20	.90	14.00	41.32	16.08	2.13	2.99	34.94	71.42	13.52	3.50	11.55
6	82.25	.75	2.02	42.00	43.36	.90	15.00	41.20	15.85	2.27	3.21	34.90	70.49	12.50	3.77	13.24
7	82.56	.75	2.00	42.00	42.29	1.00	10.00	41.82	16.99	1.74	2.13	35.10	74.96	17.42	2.41	5.21
8	82.88	.73	1.98	42.00	41.23	1.00	11.00	41.69	16.75	1.88	2.35	35.06	74.04	16.40	2.68	6.89
9	83.20	.73	1.97	42.00	40.16	1.00	12.00	41.56	16.52	2.02	2.56	35.02	73.11	15.38	2.95	8.57
28	83.53	.72	1.95	42.00	39.09	1.00	13.00	41.44	16.29	2.16	2.78	34.98	72.18	14.36	3.22	10.25
1	83.87	.71	1.93	42.00	38.02	1.00	14.00	41.31	16.06	2.29	2.99	34.94	71.25	13.33	3.48	11.94
2	82.30	.76	2.02	42.00	43.26	1.10	10.00	41.18	15.83	2.43	3.21	34.90	70.31	12.31	3.75	13.62
3	82.62	.75	2.00	42.00	42.19	1.10	11.00	41.81	16.96	1.77	2.13	35.10	74.79	17.23	2.39	5.59
4	82.94	.74	1.98	42.00	41.12	1.10	12.00	41.56	16.73	1.91	2.35	35.06	73.86	16.21	2.66	7.27
5	83.26	.74	1.96	42.00	40.05	1.10	13.00	41.43	16.50	2.04	2.56	35.02	72.93	15.19	2.93	8.95
6	83.58	.74	1.94	42.00	39.05	1.10	14.00	41.30	16.27	2.18	2.78	34.98	72.00	14.16	3.20	10.63

	LSF	SH	AH	NH	C ₃ S	C ₂ S	C ₃ A	C ₄ F	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	SaO ₅	Iron Ore	Harl
7	83.50	3.10	.73	1.95	42.00	38.99	1.10	14.00	41.30	16.03	2.18	2.99	34.94	71.07	13.14	3.47	12.32
8	83.99	2.86	.72	1.93	42.00	37.92	1.10	15.00	41.18	15.80	2.32	3.21	34.90	70.14	12.12	3.74	14.01
9	82.35	4.47	.78	2.02	42.00	43.15	1.20	10.00	41.80	16.94	1.66	2.13	35.10	74.62	17.04	2.37	5.97
240	82.67	4.04	.76	2.00	42.00	42.08	1.20	11.00	41.68	16.71	1.79	2.35	35.06	73.69	16.02	2.64	7.65
1	82.90	3.67	.75	1.98	42.00	41.02	1.20	12.00	41.55	16.47	1.93	2.56	35.02	72.76	15.00	2.91	9.33
2	83.37	3.35	.74	1.96	42.00	39.95	1.20	13.00	41.42	16.24	2.07	2.78	34.99	71.83	13.97	3.18	11.02
3	83.6c	3.08	.74	1.95	42.00	38.88	1.20	14.00	41.30	16.01	2.21	2.99	34.95	70.90	12.95	3.45	12.70
4	83.9a	2.84	.73	1.93	42.00	37.81	1.20	15.00	41.17	15.78	2.34	3.21	34.91	69.97	11.92	3.72	14.39
5	82.41	4.44	.77	2.02	42.00	43.04	1.30	10.00	41.80	16.91	1.68	2.13	35.11	74.44	16.85	2.35	6.36
6	82.77	4.01	.77	1.98	42.00	41.98	1.30	11.00	41.67	16.68	1.82	2.35	35.07	73.52	15.83	2.62	8.04
7	83.04	3.64	.76	1.98	42.00	40.91	1.30	12.00	41.54	16.45	1.95	2.56	35.03	72.59	14.80	2.89	9.72
8	83.37	3.33	.75	1.96	42.00	39.84	1.30	13.00	41.42	16.22	2.09	2.78	34.99	71.66	13.78	3.16	11.40
9	83.7n	3.06	.75	1.95	42.00	38.78	1.30	14.00	41.29	15.98	2.23	2.99	34.95	70.72	12.76	3.43	13.09
300	84.0c	2.81	.74	1.93	42.00	37.71	1.30	15.00	41.16	15.75	2.37	3.21	34.91	69.79	11.73	3.70	14.78
1	82.46	4.40	.80	2.02	42.00	42.94	1.40	10.00	41.79	16.89	1.70	2.13	35.11	74.27	16.66	2.34	6.74
2	82.7n	3.98	.78	1.98	42.00	41.87	1.40	11.00	41.67	16.66	1.84	2.35	35.07	73.34	15.64	2.60	8.42
3	83.1n	3.62	.77	1.98	42.00	40.80	1.40	12.00	41.54	16.42	1.98	2.56	35.03	72.41	14.61	2.87	10.10
4	83.4a	3.31	.76	1.94	42.00	39.74	1.40	13.00	41.41	16.19	2.12	2.78	34.99	71.48	13.59	3.14	11.78
5	83.7A	3.04	.75	1.95	42.00	38.67	1.40	14.00	41.28	15.96	2.25	2.99	34.95	70.55	12.57	3.41	13.47
6	84.0c	2.81	.75	1.93	42.00	37.60	1.40	15.00	41.16	15.73	2.39	3.21	34.91	69.62	11.54	3.68	15.16
7	82.51	4.37	.81	2.02	42.00	42.83	1.50	10.00	41.79	16.86	1.73	2.13	35.11	74.10	16.46	2.32	7.12
8	82.8a	3.95	.79	1.98	42.00	41.77	1.50	11.00	41.66	16.63	1.87	2.35	35.07	73.17	15.44	2.59	8.80
9	83.1a	3.59	.78	1.98	42.00	40.70	1.50	12.00	41.53	16.40	2.00	2.56	35.03	72.24	14.42	2.85	10.48
310	83.4R	3.29	.77	1.96	42.00	39.63	1.50	13.00	41.41	16.17	2.14	2.78	35.00	71.31	13.40	3.12	12.17
1	83.81	3.02	.76	1.95	42.00	38.56	1.50	14.00	41.28	15.93	2.28	2.99	34.96	70.38	12.38	3.39	13.85
2	84.1a	2.79	.75	1.93	42.00	37.50	1.50	15.00	41.15	15.70	2.42	3.21	34.92	69.44	11.35	3.66	15.54
3	82.57	4.33	.82	2.02	42.00	42.73	1.60	10.00	41.78	16.84	1.75	2.13	35.12	73.92	16.27	2.30	7.50
4	82.89	3.92	.81	1.98	42.00	41.66	1.60	11.00	41.65	16.61	1.89	2.35	35.08	72.99	15.25	2.57	9.18
5	83.21	3.57	.79	1.98	42.00	40.59	1.60	12.00	41.53	16.37	2.03	2.56	35.04	72.07	14.23	2.84	10.87
6	83.54	3.27	.78	1.96	42.00	39.53	1.60	13.00	41.40	16.14	2.17	2.78	35.00	71.13	13.21	3.11	12.55
7	83.87	3.00	.77	1.95	42.00	38.46	1.60	14.00	41.27	15.91	2.30	2.99	34.96	70.20	12.18	3.38	14.24
8	84.21	2.78	.76	1.93	42.00	37.39	1.60	15.00	41.14	15.68	2.44	3.21	34.92	69.27	11.16	3.65	15.93

	LSF	SH	AH	MH	C3S	C2S	C3A	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Iron Ore	Har/
350	83.21	3.76	.87	2.00	42.00	41.03	2.20	11.00	41.61	16.46	2.04	2.35	35.10	71.95	14.11	2.46	1.48
1	83.54	3.43	.85	1.98	42.00	39.96	2.20	12.00	41.49	16.23	2.17	2.56	35.06	71.02	13.09	2.73	1.16
2	83.97	3.14	.83	1.96	42.00	38.89	2.20	13.00	41.36	15.99	2.31	2.78	35.02	70.09	12.06	3.00	1.85
3	84.21	2.90	.82	1.94	42.00	37.82	2.20	14.00	41.23	15.76	2.45	2.99	34.98	69.16	11.04	3.27	1.54
4	84.55	2.68	.81	1.93	42.00	36.76	2.20	15.00	41.11	15.53	2.59	3.21	34.94	68.23	10.01	3.54	1.23
5	84.95	4.11	.90	2.01	42.00	41.99	2.30	10.00	41.73	16.66	1.92	2.13	35.14	72.71	14.94	2.17	1.18
6	85.27	3.73	.88	1.98	42.00	40.92	2.30	11.00	41.61	16.43	2.06	2.35	35.10	71.78	13.92	2.44	1.86
7	85.60	3.40	.86	1.96	42.00	39.85	2.30	12.00	41.48	16.20	2.20	2.56	35.06	70.85	12.89	2.71	1.55
8	85.99	3.12	.84	1.94	42.00	38.79	2.30	13.00	41.35	15.97	2.34	2.78	35.02	69.92	11.87	2.98	1.23
9	86.27	2.88	.83	1.94	42.00	37.72	2.30	14.00	41.23	15.74	2.47	2.99	34.98	68.99	10.85	3.25	1.92
360	84.61	2.66	.81	1.93	42.00	36.65	2.40	15.00	41.10	15.50	2.61	3.21	34.94	68.05	9.82	3.52	1.61
1	83.00	4.08	.91	2.01	42.00	41.88	2.40	10.00	41.73	16.64	1.95	2.13	35.14	72.53	14.75	2.15	1.56
2	83.39	3.70	.89	1.98	42.00	40.82	2.40	11.00	41.60	16.41	2.09	2.35	35.10	71.61	13.73	2.42	1.25
3	83.65	3.38	.87	1.96	42.00	39.75	2.40	12.00	41.47	16.18	2.22	2.56	35.07	70.68	12.70	2.69	1.93
4	83.90	3.10	.85	1.94	42.00	38.68	2.40	13.00	41.35	15.94	2.36	2.78	35.03	69.75	11.68	2.96	1.61
5	84.39	2.86	.84	1.94	42.00	37.61	2.40	14.00	41.22	15.71	2.50	2.99	34.99	68.81	10.65	3.23	1.30
6	84.67	2.65	.82	1.93	42.00	36.55	2.40	15.00	41.09	15.48	2.64	3.21	34.95	67.88	9.63	3.50	1.99
7	84.90	4.05	.93	2.01	42.00	41.78	2.50	10.00	41.72	16.61	1.97	2.13	35.17	72.36	14.56	2.14	1.95
8	85.38	3.68	.90	2.00	42.00	40.71	2.50	11.00	41.59	16.38	2.11	2.35	35.11	71.43	13.53	2.40	1.63
9	85.71	3.36	.88	1.98	42.00	39.64	2.50	12.00	41.47	16.15	2.25	2.56	35.07	70.50	12.51	2.67	1.31
370	84.09	3.09	.86	1.96	42.00	38.58	2.50	13.00	41.34	15.92	2.38	2.78	35.03	69.57	11.49	2.94	1.00
1	84.38	2.85	.84	1.94	42.00	37.51	2.50	14.00	41.21	15.69	2.52	2.99	34.99	68.64	10.46	3.21	1.69
2	84.79	2.63	.83	1.93	42.00	36.44	2.50	15.00	41.09	15.45	2.66	3.21	34.95	67.71	9.44	3.48	1.38
3	85.11	4.02	.94	2.01	42.00	41.67	2.60	10.00	41.71	16.59	2.00	2.13	35.15	72.19	14.36	2.12	1.33
4	85.43	3.65	.91	2.00	42.00	40.60	2.60	11.00	41.59	16.36	2.13	2.35	35.11	71.26	13.34	2.39	1.01
5	85.76	3.07	.89	1.98	42.00	39.54	2.60	12.00	41.46	16.13	2.27	2.56	35.07	70.33	12.32	2.66	1.69
6	86.10	2.83	.87	1.96	42.00	38.47	2.60	13.00	41.33	15.89	2.41	2.78	35.03	69.40	11.30	2.92	1.38
7	86.44	2.63	.85	1.94	42.00	37.40	2.60	14.00	41.21	15.66	2.55	2.99	34.99	68.47	10.27	3.19	1.07
8	86.78	2.62	.84	1.93	42.00	36.33	2.60	15.00	41.08	15.43	2.68	3.21	34.96	67.53	9.25	3.46	1.76
9	87.14	3.99	.95	2.01	42.00	41.57	2.70	10.00	41.71	16.57	2.02	2.13	35.15	72.01	14.17	2.10	1.71
380	83.40	3.63	.92	2.00	42.00	40.50	2.70	11.00	41.58	16.33	2.16	2.35	35.11	71.09	13.15	2.37	1.39
1	83.80	3.32	.90	1.98	42.00	39.43	2.70	12.00	41.46	16.10	2.30	2.56	35.08	70.16	12.13	2.64	1.08

	LSF	SH	AH	HH	G3S	G5	GA	CAF	GD	SU2	ALD3	FD3	LOT	LS	SADT	Ironore	Hall
2	R4.5E	3.05	.88	1.96	42.00	38.36	2.75	13.00	41.33	15.87	2.43	2.78	35.04	69.22	11.11	2.71	16.76
3	R4.5N	2.81	.86	1.94	42.00	37.30	2.70	14.00	41.20	15.64	2.57	2.99	35.00	68.29	10.08	3.17	16.45
4	R4.6W	2.60	.85	1.93	42.00	36.23	2.70	15.00	41.07	15.40	2.71	3.21	34.96	67.36	9.06	3.44	20.14
5	R3.2E	3.96	.96	2.01	42.00	41.46	2.60	10.00	41.70	16.54	2.05	2.13	35.16	71.84	13.98	2.08	12.09
6	R3.5W	3.40	.93	2.00	42.00	39.39	2.80	11.00	41.58	16.31	2.18	2.35	35.12	70.91	12.96	2.35	13.78
7	R3.8E	3.29	.91	1.98	42.00	38.33	2.80	12.00	41.45	16.08	2.32	2.56	35.08	69.98	11.94	2.62	15.46
8	R4.21	3.03	.89	1.96	42.00	38.26	2.80	13.00	41.32	15.84	2.46	2.77	35.04	69.05	10.92	2.89	17.15
9	R4.5E	2.79	.87	1.94	42.00	37.19	2.80	14.00	41.20	15.61	2.60	2.99	35.00	68.12	9.89	3.16	18.83
340	R4.9N	2.59	.85	1.93	42.00	36.12	2.80	15.00	41.07	15.38	2.73	3.21	34.96	67.19	8.86	3.43	20.52
1	R3.2E	3.93	.97	2.01	42.00	41.36	2.90	10.00	41.70	16.52	2.07	2.13	35.16	71.67	13.77	2.06	12.48
2	R3.6E	3.58	.94	2.00	42.00	40.29	2.90	11.00	41.57	16.28	2.21	2.35	35.12	70.74	12.77	2.33	14.16
3	R3.9E	3.27	.92	1.98	42.00	39.22	2.90	12.00	41.44	16.05	2.34	2.56	35.08	69.81	11.75	2.60	15.84
4	R4.2E	3.01	.89	1.96	42.00	38.15	2.90	13.00	41.32	15.82	2.48	2.77	35.04	68.88	10.72	2.87	17.53
5	R4.61	2.78	.88	1.94	42.00	37.09	2.90	14.00	41.19	15.59	2.62	2.99	35.00	67.95	9.70	3.14	19.22
6	R4.9A	2.57	.86	1.93	42.00	36.02	2.90	15.00	41.06	15.35	2.76	3.21	34.97	67.01	8.67	3.41	20.91
7	R3.33	3.90	.98	2.01	42.00	41.25	3.00	10.00	41.69	16.49	2.09	2.13	35.16	71.49	13.60	2.05	12.86
8	R3.6A	3.55	.95	1.99	42.00	40.18	3.00	11.00	41.56	16.26	2.23	2.34	35.12	70.57	12.58	2.31	14.54
9	R3.9A	3.25	.93	1.98	42.00	39.11	3.00	12.00	41.44	16.03	2.37	2.56	35.09	69.64	11.56	2.58	16.22
400	R4.33	2.99	.90	1.96	42.00	38.05	3.00	13.00	41.31	15.80	2.51	2.77	35.05	68.70	10.53	2.85	17.91
1	R4.67	2.76	.88	1.94	42.00	36.98	3.00	14.00	41.18	15.56	2.64	2.99	35.01	67.77	9.51	3.12	19.60
2	R5.02	2.56	.87	1.93	42.00	35.91	3.00	15.00	41.06	15.33	2.78	3.21	34.97	66.84	8.48	3.39	21.29
3	R3.3M	3.88	.99	2.01	42.00	41.14	3.10	10.00	41.68	16.47	2.12	2.13	35.13	71.32	13.41	2.03	13.24
4	R3.71	3.53	.96	1.99	42.00	40.08	3.10	11.00	41.56	16.23	2.26	2.34	35.13	70.39	12.39	2.30	14.92
5	R4.0A	3.23	.94	1.98	42.00	39.01	3.10	12.00	41.43	16.00	2.39	2.56	35.09	69.46	11.37	2.56	16.61
6	R4.3M	2.97	.91	1.96	42.00	37.94	3.10	13.00	41.30	15.77	2.53	2.77	35.05	68.53	10.34	2.83	18.29
7	R4.7E	2.75	.89	1.94	42.00	36.87	3.10	14.00	41.18	15.54	2.67	2.99	35.01	67.60	9.32	3.10	19.98
8	R5.0E	2.55	.88	1.93	42.00	35.81	3.10	15.00	41.05	15.31	2.81	3.21	34.97	66.66	8.29	3.37	21.67
9	R3.7E	3.4E	.86	1.91	42.00	41.04	3.20	10.00	41.68	16.44	2.14	2.13	35.17	71.15	13.22	2.01	13.62
410	R3.7E	3.50	.97	1.99	42.00	39.97	3.20	11.00	41.55	16.21	2.28	2.34	35.13	70.22	12.20	2.28	15.30
1	R4.1N	3.21	.94	1.98	42.00	38.90	3.20	12.00	41.42	15.98	2.42	2.56	35.09	69.29	11.18	2.55	16.99
2	R4.4M	2.95	.92	1.96	42.00	37.84	3.20	13.00	41.30	15.75	2.56	2.77	35.05	68.36	10.15	2.81	18.68

	LSF	SM	AM	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	C ₄ O	
3	A4.7A	2.73	.90	1.94	42.00	36.77	3.20	14.00	41.17	1
4	A5.13	2.53	.88	1.93	42.00	35.70	3.20	15.00	41.04	1
5	A3.40	3.82	1.02	2.01	42.00	40.93	3.30	10.00	41.67	1
6	A3.81	3.48	.98	1.99	42.00	39.87	3.30	11.00	41.54	1
7	A4.1A	3.19	.95	1.98	42.00	38.80	3.30	12.00	41.42	1
8	A4.50	2.94	.93	1.96	42.00	37.73	3.30	13.00	41.29	1
9	A4.8A	2.71	.91	1.94	42.00	36.66	3.30	14.00	41.16	1
420	A5.10	2.52	.89	1.93	42.00	35.60	3.30	15.00	41.04	1
1	A3.55	3.79	1.03	2.01	42.00	40.83	3.40	10.00	41.66	1
2	A3.8A	3.46	.99	1.99	42.00	39.76	3.40	11.00	41.54	1
3	A4.21	3.17	.96	1.98	42.00	38.69	3.40	12.00	41.41	1
4	A4.55	2.92	.94	1.96	42.00	37.62	3.40	13.00	41.28	1
5	A4.90	2.70	.92	1.94	42.00	36.56	3.40	14.00	41.16	1
6	A5.25	2.50	.90	1.92	42.00	35.49	3.40	15.00	41.03	1
7	A3.60	3.77	1.04	2.01	42.00	40.72	3.50	10.00	41.66	1
8	A3.9A	3.43	1.00	1.99	42.00	39.65	3.50	11.00	41.53	1
9	A4.27	3.15	.97	1.98	42.00	38.59	3.50	12.00	41.40	1
430	A4.61	2.90	.95	1.96	42.00	37.52	3.50	13.00	41.28	1
1	A4.9A	2.68	.93	1.94	42.00	36.45	3.50	14.00	41.15	1
2	A5.31	2.49	.91	1.92	42.00	35.38	3.50	15.00	41.02	1
3	A2.44	4.90	.64	2.04	44.00	42.41	.00	10.00	41.95	1
4	A2.75	4.30	.64	2.02	44.00	41.35	.00	11.00	41.83	1
5	A3.07	3.97	.64	2.00	44.00	40.29	.00	12.00	41.70	1
6	A3.40	3.61	.64	1.98	44.00	39.21	.00	13.00	41.57	1
7	A3.73	3.30	.64	1.97	44.00	38.14	.00	14.00	41.45	1
8	A4.06	3.03	.64	1.95	44.00	37.08	.00	15.00	41.32	1
9	A2.40	4.86	.65	2.04	44.00	42.31	.10	10.00	41.95	1
440	A2.81	4.36	.65	2.02	44.00	41.24	.10	11.00	41.82	1
1	A3.13	3.94	.65	2.00	44.00	40.17	.10	12.00	41.69	1
2	A3.45	3.58	.65	1.98	44.00	39.11	.10	13.00	41.57	1
3	A3.78	3.28	.65	1.97	44.00	38.04	.10	14.00	41.44	1

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Sand	Iron Ore	Marl
5.51	2.69	2.99	35.01	67.42	9.13	3.08	20.36
5.28	2.83	3.21	34.98	66.49	8.10	3.35	22.06
6.42	2.17	2.13	35.17	70.97	13.03	1.99	14.00
6.19	2.30	2.34	35.14	70.05	12.01	2.26	15.69
5.95	2.44	2.56	35.10	69.12	10.99	2.53	17.37
5.72	2.58	2.77	35.06	68.18	9.96	2.80	19.06
5.49	2.72	2.99	35.02	67.25	8.94	3.07	20.75
5.26	2.86	3.20	34.98	66.32	7.91	3.33	22.44
6.39	2.19	2.13	35.18	70.80	12.84	1.97	14.39
6.16	2.32	2.34	35.14	69.87	11.82	2.24	16.07
5.93	2.47	2.56	35.10	68.94	10.79	2.51	17.75
5.70	2.60	2.77	35.06	68.01	9.77	2.78	19.44
5.46	2.74	2.99	35.02	67.08	8.74	3.05	21.13
5.23	2.88	3.20	34.98	66.14	7.72	3.32	22.82
6.37	2.22	2.13	35.18	70.63	12.65	1.96	14.77
6.14	2.35	2.34	35.14	69.70	11.63	2.22	16.45
5.90	2.49	2.56	35.10	68.77	10.60	2.49	18.14
5.67	2.63	2.77	35.06	67.84	9.58	2.76	19.82
5.44	2.77	2.99	35.02	66.90	8.55	3.03	21.51
5.21	2.90	3.20	34.99	65.97	7.53	3.30	23.20
7.11	1.36	2.13	35.12	76.85	19.15	2.59	1.41
6.88	1.50	2.35	35.08	75.93	18.13	2.86	3.09
6.64	1.64	2.56	35.04	75.00	17.11	3.12	4.77
6.41	1.77	2.78	35.00	74.07	16.09	3.39	6.45
6.18	1.91	2.99	34.96	73.14	15.06	3.66	8.13
5.95	2.05	3.21	34.93	72.21	14.04	3.93	9.82
7.08	1.39	2.13	35.12	76.68	18.95	2.57	1.80
6.85	1.52	2.35	35.09	75.75	17.94	2.84	3.47
6.62	1.66	2.56	35.05	74.82	16.92	3.11	5.15
6.39	1.80	2.78	35.01	73.90	15.89	3.38	6.83
6.16	1.93	2.99	34.97	72.97	14.87	3.64	8.52

	LSF	SH	AH	HH	G3S	G2S	G3A	G4A	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Iron Ore	Har/
4	84.17	3.02	.65	1.95	44.00	36.97	.10	15.00	41.31	15.92	2.07	3.21	34.93	72.04	13.85	3.91	10.20
5	82.54	4.82	.66	2.04	44.00	42.20	.20	10.00	41.94	17.06	1.41	2.13	35.13	76.51	18.76	2.55	2.18
6	82.24	4.32	.66	2.02	44.00	41.14	.20	11.00	41.81	16.83	1.55	2.35	35.09	75.58	17.74	2.82	3.86
7	83.18	3.91	.66	2.00	44.00	40.07	.20	12.00	41.69	16.59	1.68	2.56	35.05	74.65	16.72	3.09	5.54
8	83.51	3.56	.66	1.98	44.00	39.06	.20	13.00	41.56	16.36	1.82	2.78	35.01	73.72	15.70	3.36	7.22
9	83.84	3.26	.65	1.97	44.00	37.93	.20	14.00	41.43	16.13	1.96	2.99	34.97	72.79	14.68	3.63	8.90
10	84.18	3.00	.65	1.95	44.00	36.87	.20	15.00	41.31	15.90	2.10	3.21	34.93	71.86	13.66	3.90	10.59
11	84.51	2.78	.67	1.95	44.00	42.10	.30	10.00	41.93	17.03	1.43	2.13	35.13	76.33	18.57	2.53	2.56
12	82.97	4.29	.67	2.02	44.00	39.96	.30	11.00	41.81	16.80	1.57	2.35	35.09	75.40	17.55	2.80	4.24
13	83.24	3.88	.67	2.00	44.00	38.90	.30	12.00	41.68	16.57	1.71	2.56	35.05	74.48	16.53	3.07	5.92
14	83.54	3.53	.66	1.98	44.00	37.83	.30	13.00	41.55	16.34	1.85	2.78	35.01	73.55	15.51	3.34	7.60
15	83.90	3.24	.66	1.97	44.00	36.76	.30	14.00	41.43	16.11	1.98	2.99	34.97	72.62	14.49	3.61	9.28
16	84.27	2.98	.66	1.95	44.00	35.70	.30	15.00	41.30	15.87	2.12	3.21	34.94	71.69	13.47	3.88	10.97
17	82.65	4.74	.68	2.04	44.00	40.99	.40	10.00	41.93	17.01	1.46	2.13	35.13	76.16	18.38	2.51	2.95
18	82.97	4.26	.68	2.02	44.00	39.92	.40	11.00	41.80	16.78	1.60	2.35	35.10	75.23	17.36	2.78	4.62
19	83.29	3.85	.68	2.00	44.00	38.86	.40	12.00	41.67	16.54	1.73	2.56	35.06	74.30	16.34	3.05	6.30
20	83.62	3.51	.67	1.98	44.00	37.79	.40	13.00	41.55	16.31	1.87	2.78	35.02	73.37	15.32	3.32	7.98
21	83.95	3.22	.67	1.97	44.00	36.72	.40	14.00	41.42	16.08	2.01	2.99	34.98	72.44	14.30	3.59	9.67
22	84.29	2.96	.67	1.95	44.00	35.65	.40	15.00	41.29	15.85	2.15	3.21	34.94	71.51	13.27	3.86	11.35
23	82.71	4.70	.70	2.04	44.00	41.89	.50	10.00	41.92	16.98	1.48	2.13	35.14	75.98	18.19	2.50	3.33
24	83.07	4.22	.69	2.02	44.00	40.82	.50	11.00	41.79	16.75	1.62	2.35	35.10	75.06	17.17	2.76	5.01
25	83.35	3.83	.69	2.00	44.00	39.75	.50	12.00	41.67	16.52	1.76	2.56	35.06	74.13	16.15	3.03	6.69
26	83.68	3.49	.68	1.98	44.00	38.68	.50	13.00	41.54	16.29	1.89	2.78	35.02	73.20	15.13	3.30	8.37
27	84.01	3.20	.68	1.96	44.00	37.62	.50	14.00	41.41	16.06	2.03	2.99	34.98	72.27	14.11	3.57	10.05
28	84.35	2.94	.68	1.95	44.00	36.55	.50	15.00	41.29	15.82	2.17	3.21	34.94	71.34	13.08	3.84	11.74
29	82.74	4.66	.71	2.04	44.00	41.78	.60	10.00	41.91	16.96	1.51	2.13	35.14	75.81	18.00	2.48	3.71
30	83.08	4.19	.70	2.02	44.00	40.71	.60	11.00	41.79	16.73	1.64	2.35	35.10	74.88	16.98	2.75	5.39
31	83.40	3.80	.70	2.00	44.00	39.65	.60	12.00	41.66	16.50	1.78	2.56	35.06	73.93	15.96	3.02	7.07
32	83.73	3.46	.69	1.98	44.00	38.58	.60	13.00	41.54	16.26	1.92	2.78	35.02	73.03	14.94	3.28	8.75
33	84.07	3.18	.69	1.96	44.00	37.51	.60	14.00	41.41	16.03	2.06	2.99	34.98	72.10	13.92	3.55	10.43
34	84.40	2.93	.68	1.95	44.00	36.44	.60	15.00	41.28	15.80	2.19	3.21	34.95	71.17	12.89	3.82	12.12

LSF	SH	AH	HH	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Sand	Iron Ore	Marl
5	4.62	.72	2.03	44.00	41.67	.70	10.00	41.91	16.93	1.53	2.13	35.14	75.64	17.81	2.46	4.09
6	4.16	.71	2.02	44.00	40.61	.70	11.00	41.78	16.70	1.67	2.35	35.11	74.71	16.79	2.73	5.77
7	3.77	.71	2.00	44.00	39.54	.70	12.00	41.66	16.47	1.81	2.56	35.07	73.78	15.77	3.00	7.45
8	3.44	.70	1.98	44.00	38.47	.70	13.00	41.53	16.24	1.94	2.78	35.03	72.85	14.75	3.27	9.13
9	3.16	.70	1.96	44.00	37.41	.70	14.00	41.40	16.01	2.08	2.99	34.99	71.92	13.72	3.54	10.82
10	2.91	.69	1.95	44.00	36.34	.70	15.00	41.26	15.77	2.22	3.21	34.95	70.99	12.70	3.81	12.50
11	4.59	.73	2.00	44.00	41.57	.80	10.00	41.90	16.91	1.56	2.13	35.15	75.46	17.62	2.44	4.48
12	4.13	.72	2.02	44.00	40.50	.80	11.00	41.78	16.68	1.69	2.35	35.11	74.54	16.60	2.71	6.16
13	3.75	.71	2.00	44.00	39.43	.80	12.00	41.65	16.45	1.83	2.56	35.07	73.61	15.58	2.98	7.84
14	3.42	.71	1.98	44.00	38.37	.80	13.00	41.52	16.21	1.97	2.78	35.03	72.68	14.56	3.25	9.52
15	3.14	.70	1.96	44.00	37.30	.80	14.00	41.40	15.98	2.11	2.99	34.99	71.75	13.53	3.52	11.20
16	2.89	.70	1.95	44.00	36.23	.80	15.00	41.27	15.75	2.24	3.21	34.95	70.82	12.51	3.79	12.89
17	4.55	.74	2.03	44.00	41.46	.90	10.00	41.90	16.88	1.58	2.13	35.15	75.29	17.43	2.42	4.86
18	4.10	.73	2.02	44.00	40.40	.90	11.00	41.77	16.65	1.72	2.35	35.11	74.36	16.41	2.69	6.54
19	3.72	.72	2.00	44.00	39.33	.90	12.00	41.64	16.42	1.85	2.56	35.07	73.43	15.39	2.96	8.22
20	3.40	.72	1.98	44.00	38.26	.90	13.00	41.52	16.19	1.99	2.78	35.03	72.51	14.36	3.23	9.90
21	3.12	.71	1.96	44.00	37.19	.90	14.00	41.39	15.96	2.13	2.99	35.00	71.58	13.34	3.50	11.58
22	2.87	.71	1.95	44.00	36.13	.90	15.00	41.26	15.72	2.27	3.21	34.96	70.64	12.32	3.77	13.27
23	4.51	.75	2.03	44.00	41.36	1.00	10.00	41.89	16.86	1.60	2.13	35.15	75.12	17.24	2.41	5.24
24	4.07	.74	2.02	44.00	40.29	1.00	11.00	41.76	16.63	1.74	2.35	35.12	74.19	16.22	2.67	6.92
25	3.69	.73	2.00	44.00	39.22	1.00	12.00	41.64	16.40	1.88	2.56	35.08	73.26	15.20	2.94	8.60
26	3.37	.73	1.98	44.00	38.16	1.00	13.00	41.51	16.16	2.02	2.78	35.04	72.33	14.17	3.21	10.28
27	3.10	.72	1.96	44.00	37.09	1.00	14.00	41.38	15.93	2.15	2.99	35.00	71.40	13.15	3.48	11.97
28	2.86	.71	1.95	44.00	36.02	1.00	15.00	41.26	15.70	2.29	3.21	34.96	70.47	12.13	3.75	13.65
29	4.48	.76	2.03	44.00	41.25	1.10	10.00	41.88	16.83	1.61	2.13	35.16	74.94	17.04	2.39	5.63
30	4.04	.75	2.02	44.00	40.19	1.10	11.00	41.76	16.60	1.77	2.35	35.12	74.02	16.03	2.66	7.30
31	3.68	.74	2.00	44.00	39.12	1.10	12.00	41.63	16.37	1.90	2.56	35.08	73.09	15.00	2.92	8.98
32	3.35	.74	1.98	44.00	38.05	1.10	13.00	41.50	16.14	2.04	2.77	35.04	72.16	13.98	3.19	10.67
33	3.08	.73	1.96	44.00	36.98	1.10	14.00	41.38	15.91	2.18	2.99	35.00	71.23	12.96	3.46	12.35
34	2.84	.72	1.95	44.00	35.92	1.10	15.00	41.25	15.67	2.32	3.21	34.96	70.30	11.93	3.73	14.04
35	4.44	.78	2.03	44.00	41.15	1.20	10.00	41.80	16.81	1.65	2.13	35.16	74.77	16.85	2.37	6.01
36	4.01	.76	2.02	44.00	40.08	1.20	11.00	41.75	16.58	1.79	2.35	35.12	73.84	15.83	2.64	7.69

LSF	SH	AH	HH	G3S	G2S	G3A	G4F	CdO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Sand	Free Ore	Hard
183.78	3.64	.75	2.00	44.00	39.01	1.20	12.00	41.62	16.35	1.93	2.56	35.08	72.91	14.81	2.91	9.37
184.41	3.06	.74	1.98	44.00	37.94	1.20	13.00	41.50	16.11	2.07	2.77	35.04	71.98	13.79	3.18	11.05
184.75	2.82	.73	1.96	44.00	36.88	1.20	14.00	41.37	15.88	2.20	2.99	35.01	71.05	12.77	3.44	12.73
183.14	4.41	.79	1.95	44.00	35.81	1.20	15.00	41.24	15.65	2.34	3.21	34.97	70.12	11.74	3.71	14.42
203.44	3.98	.77	2.03	44.00	39.97	1.30	11.00	41.87	16.78	1.68	2.13	35.16	74.60	16.66	2.35	6.39
183.70	3.62	.76	2.02	44.00	38.91	1.30	11.00	41.74	16.55	1.82	2.34	35.13	73.67	15.64	2.62	8.07
184.11	3.31	.75	2.00	44.00	37.91	1.30	12.00	41.62	16.32	1.95	2.56	35.09	72.74	14.62	2.89	9.75
184.46	3.04	.75	1.98	44.00	37.84	1.30	13.00	41.49	16.09	2.09	2.77	35.05	71.81	13.60	3.16	11.43
184.81	2.80	.74	1.96	44.00	36.77	1.30	14.00	41.36	15.86	2.23	2.99	35.01	70.88	12.58	3.43	13.12
183.19	4.37	.80	1.95	44.00	35.70	1.30	15.00	41.24	15.62	2.37	3.21	34.97	69.95	11.55	3.70	14.80
183.59	3.95	.78	2.03	44.00	39.87	1.40	10.00	41.86	16.78	1.70	2.13	35.17	74.42	16.47	2.33	6.77
184.14	3.29	.76	2.02	44.00	38.80	1.40	11.00	41.74	16.53	1.84	2.34	35.13	73.50	15.45	2.60	8.45
184.86	2.79	.75	1.98	44.00	37.73	1.40	12.00	41.61	16.30	1.98	2.56	35.09	72.57	14.43	2.87	10.13
184.59	3.02	.75	1.96	44.00	36.67	1.40	13.00	41.48	16.06	2.11	2.77	35.05	71.64	13.41	3.14	11.81
184.86	2.79	.75	1.96	44.00	35.60	1.40	14.00	41.36	15.83	2.25	2.99	35.01	70.71	12.39	3.41	13.50
183.22	4.34	.81	1.95	44.00	40.83	1.50	10.00	41.23	15.60	2.39	3.21	34.97	69.78	11.36	3.68	15.19
183.57	3.92	.78	2.03	44.00	39.76	1.50	11.00	41.08	16.74	1.73	2.13	35.17	74.25	16.28	2.31	7.16
184.94	3.57	.78	2.01	44.00	38.70	1.50	12.00	41.73	16.50	1.86	2.34	35.13	73.32	15.26	2.58	8.83
184.24	3.26	.77	1.98	44.00	37.63	1.50	13.00	41.60	16.27	1.90	2.56	35.09	72.39	14.24	2.85	10.51
184.54	3.00	.76	1.96	44.00	36.56	1.50	14.00	41.48	16.04	2.14	2.77	35.05	71.46	13.22	3.12	12.20
184.99	4.31	.75	1.95	44.00	35.49	1.50	15.00	41.35	15.81	2.28	2.99	35.02	70.53	12.19	3.39	13.88
183.30	3.54	.82	2.03	44.00	40.72	1.60	10.00	41.22	15.58	2.41	3.21	34.98	69.60	11.17	3.66	15.57
183.63	3.89	.81	2.00	44.00	38.59	1.60	11.00	41.08	16.71	1.75	2.13	35.18	74.08	16.09	2.30	7.54
184.20	3.24	.78	1.98	44.00	37.52	1.60	12.00	41.60	16.25	1.89	2.34	35.14	73.15	15.07	2.56	9.22
184.69	2.98	.77	1.96	44.00	36.45	1.60	13.00	41.47	16.02	2.16	2.77	35.06	72.22	14.05	2.83	10.90
184.94	2.76	.76	1.94	44.00	35.38	1.60	14.00	41.32	15.78	2.30	2.99	35.02	71.29	13.03	3.10	12.58
183.34	4.27	.83	1.94	44.00	40.62	1.70	10.00	41.22	15.55	2.44	3.20	34.98	69.36	12.00	3.37	14.27
183.64	3.87	.82	2.03	44.00	39.55	1.70	11.00	41.84	16.49	1.78	2.13	35.18	73.43	16.98	2.64	15.95
184.01	3.52	.80	2.00	44.00	38.48	1.70	12.00	41.72	16.45	1.91	2.34	35.14	72.97	15.88	2.55	17.62
184.01	3.52	.80	2.00	44.00	38.48	1.70	12.00	41.59	16.22	2.05	2.56	35.10	72.05	14.86	2.82	19.28

	LSF	SH	AH	HH	G5	G25	G3A	G4F	CaD	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Iron Ore	Hay
8	84.35	3.22	.79	1.98	44.00	37.42	1.70	13.00	41.46	15.99	2.19	2.77	35.06	71.12	12.84	3.08	12.96
7	84.69	2.97	.78	1.96	44.00	36.35	1.70	14.00	41.34	15.76	2.33	2.99	35.02	70.19	11.81	3.35	14.65
6	85.04	2.79	.77	1.94	44.00	35.28	1.70	15.00	41.21	15.53	2.46	3.20	34.98	69.25	10.79	3.62	16.34
5	83.41	4.24	.85	2.03	44.00	40.51	1.80	10.00	41.84	16.46	1.80	2.13	35.18	73.73	15.71	2.26	8.30
4	83.74	3.84	.83	2.00	44.00	39.45	1.80	11.00	41.71	16.43	1.94	2.34	35.14	72.80	14.69	2.53	9.98
3	84.07	3.50	.81	2.00	44.00	38.38	1.80	12.00	41.59	16.29	2.07	2.56	35.10	71.87	13.67	2.80	11.66
2	84.41	3.20	.80	1.98	44.00	37.31	1.80	13.00	41.46	15.97	2.21	2.77	35.06	70.94	12.65	3.07	13.35
1	84.76	2.95	.79	1.96	44.00	36.24	1.80	14.00	41.33	15.73	2.35	2.99	35.03	70.01	11.62	3.34	15.03
6	85.10	2.72	.78	1.94	44.00	35.16	1.80	15.00	41.20	15.50	2.49	3.20	34.99	69.08	10.60	3.60	16.72
7	83.79	4.21	.86	2.03	44.00	40.41	1.90	10.00	41.83	16.64	1.82	2.13	35.19	73.56	15.52	2.24	8.68
8	83.79	3.81	.84	2.01	44.00	39.34	1.90	11.00	41.71	16.40	1.96	2.34	35.15	72.43	14.50	2.51	10.36
9	84.13	3.47	.82	2.00	44.00	38.27	1.90	12.00	41.58	16.17	2.10	2.56	35.11	71.70	13.48	2.78	12.05
10	84.46	3.16	.81	1.98	44.00	37.21	1.90	13.00	41.45	15.94	2.24	2.77	35.07	70.77	12.45	3.05	13.73
11	84.81	2.93	.79	1.96	44.00	36.14	1.90	14.00	41.33	15.71	2.37	2.99	35.03	69.84	11.43	3.32	15.41
12	85.15	2.71	.78	1.94	44.00	35.07	1.90	15.00	41.20	15.48	2.51	3.20	34.99	68.91	10.41	3.59	17.10
13	83.55	4.11	.87	2.03	44.00	40.30	2.00	10.00	41.83	16.61	1.85	2.13	35.19	73.38	15.33	2.22	9.07
14	83.55	3.78	.85	2.01	44.00	39.23	2.00	11.00	41.70	16.38	1.99	2.34	35.15	72.45	14.31	2.49	10.75
15	84.11	3.45	.83	2.00	44.00	38.17	2.00	12.00	41.57	16.15	2.12	2.56	35.11	71.53	13.29	2.76	12.43
16	84.57	3.16	.82	1.98	44.00	37.10	2.00	13.00	41.45	15.92	2.26	2.77	35.07	70.60	12.26	3.03	14.11
17	84.11	2.91	.80	1.96	44.00	36.03	2.00	14.00	41.32	15.68	2.40	2.99	35.03	69.67	11.24	3.30	15.80
18	84.57	2.65	.79	1.94	44.00	34.96	2.00	15.00	41.19	15.45	2.54	3.20	34.99	68.73	10.21	3.57	17.48
19	83.57	4.14	.88	2.03	44.00	40.20	2.10	10.00	41.82	16.59	1.87	2.13	35.19	73.21	15.14	2.21	9.45
20	83.91	3.76	.86	2.01	44.00	39.13	2.10	11.00	41.69	16.36	2.01	2.34	35.15	72.28	14.12	2.47	11.13
21	84.24	3.43	.84	2.00	44.00	38.06	2.10	12.00	41.57	16.12	2.15	2.56	35.11	71.35	13.09	2.74	12.81
22	84.58	3.14	.82	1.98	44.00	36.99	2.10	13.00	41.44	15.89	2.28	2.77	35.08	70.42	12.07	3.01	14.49
23	84.97	2.89	.81	1.96	44.00	35.93	2.10	14.00	41.31	15.66	2.42	2.99	35.04	69.49	11.05	3.28	16.18
24	85.27	2.68	.80	1.94	44.00	34.86	2.10	15.00	41.19	15.43	2.56	3.20	35.00	68.56	10.02	3.55	17.87
25	83.61	4.11	.89	2.03	44.00	40.09	2.20	10.00	41.81	16.56	1.90	2.13	35.20	73.04	14.95	2.19	9.83
26	83.94	3.73	.87	2.01	44.00	39.02	2.20	11.00	41.64	16.33	2.03	2.34	35.16	72.11	13.93	2.46	11.51
27	84.20	3.40	.85	2.00	44.00	37.96	2.20	12.00	41.56	16.10	2.17	2.56	35.12	71.18	12.90	2.72	13.19
28	84.63	3.12	.83	1.98	44.00	36.89	2.20	13.00	41.43	15.87	2.31	2.77	35.08	70.25	11.88	2.99	14.88
29	84.98	2.88	.82	1.96	44.00	35.82	2.20	14.00	41.31	15.63	2.45	2.99	35.04	69.32	10.86	3.26	16.56

LSF	SH	AH	HH	CS	CS	CSA	C4AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	BS	SAN	Iron Ore	Harl
1	2.66	.81	1.94	44.00	34.75	2.20	15.00	41.18	15.40	2.58	3.20	35.00	68.37	9.83	3.53	18.25
2	4.08	.90	2.03	44.00	39.99	2.30	10.00	41.81	16.54	1.92	2.13	35.20	72.86	14.76	2.17	10.21
3	3.70	.88	2.01	44.00	38.92	2.30	11.00	41.68	16.31	2.06	2.34	35.16	71.93	13.73	2.44	11.89
4	3.38	.86	1.99	44.00	37.85	2.30	12.00	41.55	16.07	2.20	2.56	35.12	71.01	12.71	2.71	13.58
5	3.10	.84	1.98	44.00	36.78	2.30	13.00	41.43	15.84	2.33	2.77	35.08	70.08	11.69	2.97	15.26
6	2.86	.83	1.96	44.00	35.72	2.30	14.00	41.30	15.61	2.47	2.99	35.04	69.14	10.67	3.24	16.94
7	2.65	.81	1.94	44.00	34.65	2.30	15.00	41.17	15.38	2.61	3.20	35.00	68.21	9.64	3.51	18.63
8	4.05	.91	2.03	44.00	39.88	2.40	10.00	41.80	16.51	1.55	2.13	35.20	72.69	14.56	2.15	10.60
9	3.68	.89	2.01	44.00	38.81	2.40	11.00	41.67	16.28	2.08	2.34	35.16	71.76	13.54	2.42	12.28
10	3.36	.87	1.99	44.00	37.74	2.40	12.00	41.55	16.05	2.22	2.56	35.12	70.83	12.52	2.69	13.96
11	3.08	.85	1.98	44.00	36.68	2.40	13.00	41.42	15.82	2.36	2.77	35.09	69.90	11.50	2.96	15.64
12	2.84	.84	1.96	44.00	35.61	2.40	14.00	41.29	15.59	2.50	2.99	35.05	68.97	10.48	3.23	17.33
13	2.63	.82	1.94	44.00	34.54	2.40	15.00	41.17	15.35	2.63	3.20	35.01	68.04	9.45	3.50	19.02
14	4.02	.93	2.03	44.00	39.77	2.50	10.00	41.79	16.49	1.97	2.13	35.21	72.52	14.37	2.13	10.98
15	3.65	.90	2.01	44.00	38.71	2.50	11.00	41.67	16.26	2.11	2.34	35.17	71.59	13.35	2.40	12.66
16	3.34	.88	1.99	44.00	37.64	2.50	12.00	41.54	16.02	2.24	2.56	35.13	70.66	12.33	2.67	14.34
17	3.06	.86	1.98	44.00	36.57	2.50	13.00	41.41	15.79	2.38	2.77	35.09	69.73	11.31	2.94	16.02
18	2.82	.84	1.96	44.00	35.50	2.50	14.00	41.29	15.56	2.52	2.99	35.05	68.80	10.28	3.21	17.71
19	2.62	.83	1.94	44.00	34.44	2.50	15.00	41.16	15.33	2.66	3.20	35.01	67.87	9.26	3.48	19.40
20	3.99	.94	2.03	44.00	39.67	2.60	10.00	41.79	16.46	1.99	2.13	35.21	72.34	14.18	2.12	11.36
21	3.63	.91	2.01	44.00	38.60	2.60	11.00	41.66	16.23	2.13	2.34	35.17	71.41	13.16	2.38	13.04
22	3.31	.89	1.99	44.00	37.53	2.60	12.00	41.53	16.00	2.27	2.56	35.13	70.49	12.14	2.65	14.72
23	3.04	.87	1.98	44.00	36.47	2.60	13.00	41.41	15.77	2.41	2.77	35.09	69.56	11.12	2.92	16.41
24	2.81	.85	1.96	44.00	35.40	2.60	14.00	41.28	15.54	2.54	2.99	35.05	68.62	10.09	3.19	18.09
25	2.60	.84	1.94	44.00	34.33	2.60	15.00	41.15	15.30	2.68	3.20	35.01	67.69	9.07	3.46	19.78
26	3.96	.95	2.03	44.00	39.56	2.70	10.00	41.78	16.44	2.02	2.13	35.21	72.17	13.97	2.10	11.74
27	3.60	.92	2.01	44.00	38.50	2.70	11.00	41.65	16.21	2.16	2.34	35.17	71.24	12.97	2.37	13.42
28	3.29	.90	1.99	44.00	37.43	2.70	12.00	41.53	15.98	2.29	2.56	35.13	70.31	11.95	2.62	15.10
29	3.03	.88	1.98	44.00	36.36	2.70	13.00	41.40	15.74	2.43	2.77	35.10	69.38	10.93	2.90	16.79
30	2.79	.86	1.96	44.00	35.29	2.70	14.00	41.27	15.51	2.57	2.99	35.06	68.45	9.90	3.17	18.48
31	2.59	.85	1.94	44.00	34.23	2.70	15.00	41.15	15.28	2.71	3.20	35.02	67.52	8.88	3.44	20.16

	LDF	SH	AH	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	C ₂ O	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	LS	Sand	Iron Ore	Marl
600	83.96	3.93	.96	2.03	44.00	39.46	2.80	10.00	41.77	16.41	2.04	2.13	35.22	72.00	13.80	2.08	12.12
2	84.30	3.58	.93	2.01	44.00	38.39	2.80	11.00	41.65	16.18	2.18	2.34	35.18	71.07	12.78	2.35	13.80
3	84.64	3.27	.91	1.99	44.00	37.32	2.80	12.00	41.52	15.95	2.32	2.56	35.14	70.14	11.76	2.62	15.49
4	84.98	3.01	.89	1.98	44.00	36.25	2.80	13.00	41.39	15.72	2.46	2.77	35.10	69.21	10.74	2.88	17.17
5	85.32	2.77	.87	1.96	44.00	35.19	2.80	14.00	41.27	15.49	2.59	2.99	35.06	68.28	9.71	3.15	18.86
6	85.66	2.57	.85	1.94	44.00	34.12	2.80	15.00	41.14	15.25	2.73	3.20	35.02	67.34	8.69	3.42	20.55
7	84.02	3.91	.97	2.03	44.00	39.35	2.90	10.00	41.77	16.39	2.07	2.13	35.22	71.82	13.61	2.06	12.51
8	84.35	3.52	.94	2.01	44.00	38.28	2.90	11.00	41.64	16.16	2.20	2.34	35.18	70.89	12.59	2.33	14.19
9	84.69	3.25	.92	1.99	44.00	37.22	2.90	12.00	41.51	15.93	2.34	2.55	35.14	69.97	11.57	2.60	15.87
10	85.04	2.99	.89	1.98	44.00	36.15	2.90	13.00	41.39	15.69	2.48	2.77	35.10	69.03	10.55	2.87	17.55
11	85.39	2.76	.88	1.96	44.00	35.08	2.90	14.00	41.26	15.46	2.62	2.99	35.06	68.10	9.52	3.13	19.24
12	85.74	2.56	.86	1.94	44.00	34.01	2.90	15.00	41.13	15.23	2.76	3.20	35.02	67.17	8.50	3.40	20.93
13	84.07	3.88	.98	2.03	44.00	39.25	3.00	10.00	41.76	16.36	2.09	2.13	35.22	71.65	13.42	2.04	12.89
14	84.41	3.53	.95	2.01	44.00	38.18	3.00	11.00	41.63	16.13	2.23	2.34	35.18	70.72	12.40	2.31	14.57
15	84.75	3.23	.93	1.99	44.00	37.11	3.00	12.00	41.51	15.90	2.37	2.56	35.14	69.79	11.38	2.58	16.25
16	85.09	2.97	.90	1.98	44.00	36.04	3.00	13.00	41.38	15.67	2.50	2.77	35.11	68.86	10.36	2.85	17.94
17	85.43	2.74	.88	1.96	44.00	34.98	3.00	14.00	41.25	15.44	2.64	2.99	35.07	67.93	9.33	3.12	19.62
18	85.78	2.54	.87	1.94	44.00	33.91	3.00	15.00	41.13	15.20	2.73	3.20	35.03	67.00	8.31	3.39	21.31
19	84.12	3.85	.99	2.03	44.00	39.14	3.10	10.00	41.75	16.34	2.12	2.13	35.23	71.48	13.23	2.03	13.27
20	84.46	3.50	.96	2.01	44.00	38.07	3.10	11.00	41.63	16.11	2.25	2.34	35.19	70.55	12.21	2.29	14.95
21	84.81	3.21	.94	1.99	44.00	37.01	3.10	12.00	41.50	15.88	2.39	2.56	35.15	69.62	11.19	2.56	16.63
22	85.15	2.95	.91	1.98	44.00	35.94	3.10	13.00	41.38	15.64	2.53	2.77	35.11	68.69	10.16	2.83	18.32
23	85.50	2.73	.89	1.96	44.00	34.87	3.10	14.00	41.25	15.41	2.67	2.99	35.07	67.76	9.14	3.10	20.00
24	85.85	2.53	.88	1.94	44.00	33.80	3.10	15.00	41.12	15.18	2.80	3.20	35.03	66.82	8.11	3.37	21.69
25	84.19	3.82	1.01	2.03	44.00	39.03	3.20	10.00	41.75	16.31	2.14	2.13	35.23	71.30	13.04	2.01	13.65
26	84.53	3.40	.97	2.01	44.00	37.97	3.20	11.00	41.62	16.08	2.28	2.34	35.19	70.37	12.02	2.27	15.33
27	84.88	3.19	.94	1.99	44.00	36.90	3.20	12.00	41.50	15.85	2.42	2.56	35.15	69.45	11.00	2.54	17.01
28	85.21	2.93	.92	1.98	44.00	35.83	3.20	13.00	41.37	15.62	2.55	2.77	35.11	68.51	9.97	2.81	18.70
29	85.56	2.71	.90	1.96	44.00	34.76	3.20	14.00	41.24	15.39	2.69	2.99	35.07	67.58	8.95	3.08	20.39
30	85.91	2.51	.88	1.94	44.00	33.70	3.20	15.00	41.12	15.15	2.83	3.20	35.03	66.65	7.92	3.35	22.08
31	84.24	3.79	1.02	2.03	44.00	38.93	3.30	10.00	41.74	16.29	2.17	2.13	35.23	71.13	12.85	1.99	14.03
32	84.58	3.44	.98	2.01	44.00	37.86	3.30	11.00	41.62	16.06	2.30	2.34	35.19	70.20	11.83	2.26	15.71

LSF	SH	AH	HH	CS	CS	CSA	CAF	CAO	SU2	AL03	EO3	LOI	LS	Sand	from Ore	Hard
3 84.99	3.17	.95	1.99	44.00	36.79	3.30	12.00	41.44	15.83	2.44	2.56	35.15	69.27	10.81	2.52	17.46
4 85.27	2.92	.93	1.97	44.00	35.73	3.30	13.00	41.36	15.59	2.58	2.77	35.12	68.34	9.78	2.79	19.08
5 85.41	2.67	.91	1.96	44.00	34.66	3.30	14.00	41.24	15.36	2.72	2.99	35.08	67.41	8.76	3.06	20.77
6 85.98	2.50	.89	1.94	44.00	33.59	3.30	15.00	41.11	15.13	2.85	3.20	35.04	66.48	7.73	3.33	22.46
7 84.38	3.77	1.03	2.03	44.00	38.82	3.40	10.00	41.74	16.27	2.19	2.13	35.24	70.96	12.66	1.97	14.41
8 84.68	3.43	.99	2.01	44.00	37.76	3.40	11.00	41.61	16.03	2.33	2.34	35.20	70.03	11.64	2.24	16.10
9 84.98	3.15	.96	1.99	44.00	36.69	3.40	12.00	41.48	15.80	2.46	2.56	35.16	69.10	10.62	2.51	17.78
10 85.32	2.90	.94	1.97	44.00	35.62	3.40	13.00	41.36	15.57	2.60	2.77	35.12	68.17	9.59	2.78	19.46
11 85.62	2.68	.92	1.96	44.00	34.55	3.40	14.00	41.23	15.34	2.74	2.99	35.08	67.24	8.57	3.04	21.15
12 86.04	2.48	.90	1.94	44.00	33.49	3.40	15.00	41.10	15.11	2.88	3.20	35.04	66.30	7.54	3.31	22.84
13 84.35	3.74	1.04	2.03	44.00	38.72	3.50	10.00	41.73	16.24	2.21	2.13	35.24	70.78	12.47	1.95	14.80
14 84.68	3.41	1.00	2.01	44.00	37.65	3.50	11.00	41.60	16.01	2.35	2.34	35.20	69.86	11.45	2.22	16.48
15 85.04	3.13	.97	1.99	44.00	36.58	3.50	12.00	41.48	15.78	2.49	2.56	35.16	68.93	10.43	2.49	18.16
16 85.38	2.88	.95	1.97	44.00	35.52	3.50	13.00	41.35	15.55	2.63	2.77	35.12	68.00	9.40	2.76	19.85
17 85.74	2.66	.93	1.96	44.00	34.45	3.50	14.00	41.22	15.31	2.76	2.99	35.08	67.06	8.38	3.03	21.53
18 86.10	2.47	.91	1.94	44.00	33.38	3.50	15.00	41.10	15.08	2.90	3.20	35.04	66.13	7.35	3.29	23.22
19 83.17	4.07	.64	2.05	46.00	40.41	.00	10.00	42.02	16.98	1.36	2.13	35.18	77.00	16.96	2.58	1.45
20 83.49	4.36	.64	2.03	46.00	39.34	.00	11.00	41.90	16.75	1.50	2.34	35.14	76.08	17.94	2.85	3.13
21 83.89	3.94	.64	2.02	46.00	38.28	.00	12.00	41.77	16.52	1.63	2.56	35.10	75.15	16.92	3.12	4.81
22 84.18	3.58	.64	2.00	46.00	37.21	.00	13.00	41.65	16.28	1.77	2.77	35.06	74.22	15.90	3.39	6.49
23 84.48	3.28	.64	1.98	46.00	36.14	.00	14.00	41.52	16.05	1.91	2.99	35.02	73.29	14.88	3.66	8.17
24 84.81	3.01	.64	1.96	46.00	35.07	.00	15.00	41.39	15.82	2.05	3.20	34.98	72.36	13.86	3.93	9.85
25 83.22	4.82	.65	2.05	46.00	40.30	.10	10.00	42.02	16.95	1.38	2.34	35.18	76.83	18.77	2.57	1.84
26 83.54	4.33	.65	2.03	46.00	39.24	.10	11.00	41.89	16.72	1.52	2.56	35.14	75.90	17.75	2.83	3.51
27 83.87	3.91	.65	2.02	46.00	38.17	.10	12.00	41.77	16.49	1.66	2.77	35.10	74.98	16.73	3.10	5.19
28 84.21	3.56	.65	2.00	46.00	37.10	.10	13.00	41.64	16.26	1.80	2.99	35.07	74.05	15.71	3.37	6.87
29 84.54	3.26	.65	1.98	46.00	36.04	.10	14.00	41.51	16.03	1.93	3.20	35.03	73.12	14.69	3.64	8.55
30 84.89	2.99	.65	1.96	46.00	34.97	.10	15.00	41.39	15.80	2.07	3.42	34.99	72.19	13.67	3.91	10.23
31 83.27	4.78	.66	2.05	46.00	40.20	.20	10.00	42.01	16.93	1.41	2.13	35.19	76.66	18.58	2.55	2.22
32 83.66	4.29	.66	2.03	46.00	39.13	.20	11.00	41.87	16.70	1.55	2.34	35.15	75.73	17.56	2.82	3.89

	LSF	SH	AH	HM	C3S	C2S	C3A	C4F	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	SAND	Ironore	Marl
3	83.91	3.88	.66	2.02	46.00	38.06	20.12	.00	41.76	16.47	1.68	2.56	35.11	74.80	16.54	3.08	5.57
4	84.26	3.53	.66	2.00	46.00	37.00	20.13	.00	41.63	16.24	1.82	2.77	35.07	73.88	15.52	3.35	7.25
5	84.61	3.24	.65	1.98	46.00	35.93	20.14	.00	41.51	16.00	1.96	2.99	35.03	72.95	14.50	3.62	8.93
6	84.95	2.98	.65	1.96	46.00	34.86	20.15	.00	41.38	15.77	2.09	3.20	34.99	72.02	13.47	3.89	10.62
7	83.31	4.75	.67	2.05	46.00	40.09	30.10	.00	42.01	16.91	1.43	2.13	35.19	76.48	18.39	2.53	2.60
8	83.65	4.26	.67	2.03	46.00	37.03	30.11	.00	41.88	16.67	1.57	2.34	35.15	75.56	17.37	2.80	4.28
9	83.99	3.85	.67	2.00	46.00	37.96	30.12	.00	41.75	16.44	1.71	2.56	35.11	74.63	16.35	3.07	5.96
10	84.33	3.51	.66	2.00	46.00	36.85	30.13	.00	41.63	16.21	1.84	2.77	35.07	73.70	15.33	3.34	7.63
11	84.64	3.21	.66	1.98	46.00	35.82	30.14	.00	41.50	15.98	1.98	2.99	35.03	72.77	14.31	3.60	9.32
12	85.00	2.96	.66	1.96	46.00	34.76	30.15	.00	41.37	15.75	2.12	3.20	34.99	71.84	13.28	3.87	11.00
13	83.38	4.71	.68	2.05	46.00	39.99	40.10	.00	42.00	16.88	1.46	2.13	35.19	76.31	18.20	2.51	2.98
14	83.71	4.23	.68	2.03	46.00	38.92	40.11	.00	41.87	16.65	1.59	2.34	35.15	75.38	17.18	2.78	4.66
15	84.04	3.93	.68	2.02	46.00	37.85	40.12	.00	41.75	16.42	1.73	2.56	35.12	74.46	16.16	3.05	6.34
16	84.37	3.49	.67	2.00	46.00	36.79	40.13	.00	41.62	16.19	1.87	2.77	35.08	73.53	15.14	3.32	8.02
17	84.71	3.19	.67	1.98	46.00	35.72	40.14	.00	41.49	15.95	2.01	2.99	35.04	72.60	14.12	3.59	9.70
18	85.04	2.94	.67	1.96	46.00	34.65	40.15	.00	41.37	15.72	2.14	3.20	35.00	71.67	13.09	3.86	11.38
19	83.44	4.67	.70	2.05	46.00	39.84	50.10	.00	41.99	16.86	1.48	2.13	35.20	76.13	16.01	2.49	3.37
20	83.74	4.20	.69	2.03	46.00	38.82	50.11	.00	41.87	16.62	1.62	2.34	35.16	75.21	15.99	2.76	5.04
21	84.00	3.80	.69	2.02	46.00	37.75	50.12	.00	41.74	16.39	1.76	2.56	35.12	74.28	15.97	3.03	6.72
22	84.41	3.46	.68	2.00	46.00	36.68	50.13	.00	41.61	16.16	1.89	2.77	35.08	73.35	14.95	3.30	8.40
23	84.77	3.17	.68	1.98	46.00	35.61	50.14	.00	41.49	15.93	2.03	2.99	35.04	72.43	13.92	3.57	10.08
24	85.13	2.92	.68	1.96	46.00	34.54	50.15	.00	41.36	15.70	2.17	3.20	35.00	71.50	12.90	3.84	11.77
25	83.49	4.63	.71	2.05	46.00	39.78	60.10	.00	41.99	16.82	1.51	2.13	35.20	75.96	17.81	2.47	3.75
26	83.81	4.16	.70	2.03	46.00	38.71	60.11	.00	41.86	16.60	1.64	2.34	35.16	75.04	16.80	2.74	5.43
27	84.15	3.77	.70	2.02	46.00	37.64	60.12	.00	41.73	16.37	1.78	2.56	35.12	74.11	15.78	3.01	7.10
28	84.49	3.44	.69	2.00	46.00	36.57	60.13	.00	41.61	16.14	1.92	2.77	35.08	73.18	14.76	3.28	8.78
29	84.83	3.15	.69	1.98	46.00	35.51	60.14	.00	41.48	15.90	2.05	2.99	35.04	72.25	13.73	3.55	10.47
30	85.19	2.90	.68	1.96	46.00	34.44	60.15	.00	41.35	15.67	2.19	3.20	35.00	71.32	12.71	3.82	12.15
31	83.55	4.59	.72	2.05	46.00	39.67	70.10	.00	41.98	16.81	1.53	2.13	35.20	75.79	17.62	2.46	4.13
32	83.87	4.13	.71	2.03	46.00	38.60	70.11	.00	41.85	16.57	1.67	2.34	35.16	74.86	16.61	2.72	5.81
33	84.21	3.75	.71	2.02	46.00	37.54	70.12	.00	41.73	16.34	1.80	2.56	35.13	73.94	15.59	2.99	7.49
34	84.54	3.42	.70	2.00	46.00	36.47	70.13	.00	41.60	16.11	1.94	2.77	35.09	73.01	14.56	3.26	9.17

LSF	SH	AH	HH	C3S	C2S	C3A	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Iron Ore	Harl
5	14.89	.70	1.98	46.00	35.40	.70	14.00	41.47	15.88	2.08	2.99	35.05	72.09	13.54	3.53	10.85
6	15.23	.69	1.96	46.00	34.33	.70	15.00	41.35	15.65	2.22	3.20	35.01	71.15	12.52	3.80	12.53
7	13.60	.73	2.05	46.00	39.57	.80	10.00	41.97	16.78	1.55	2.13	35.21	75.61	17.43	2.44	4.51
8	13.93	.72	2.03	46.00	38.50	.80	11.00	41.85	16.55	1.69	2.34	35.17	74.69	16.41	2.71	6.19
9	14.24	.71	2.01	46.00	37.43	.80	12.00	41.72	16.32	1.83	2.56	35.13	73.76	15.39	2.98	7.87
10	14.60	.71	2.00	46.00	36.36	.80	13.00	41.59	16.09	1.97	2.77	35.09	72.83	14.37	3.24	9.55
11	14.94	.70	1.98	46.00	35.30	.80	14.00	41.47	15.85	2.10	2.99	35.05	71.90	13.35	3.51	11.23
12	15.29	.70	1.96	46.00	34.23	.80	15.00	41.34	15.62	2.24	3.20	35.01	70.97	12.33	3.78	12.92
13	13.64	.74	2.05	46.00	39.46	.90	10.00	41.97	16.76	1.58	2.13	35.21	75.44	17.24	2.42	4.90
14	13.90	.73	2.03	46.00	38.39	.90	11.00	41.84	16.53	1.72	2.34	35.17	74.52	16.22	2.69	6.57
15	14.37	.72	2.01	46.00	37.33	.90	12.00	41.71	16.29	1.85	2.56	35.13	73.59	15.20	2.96	8.25
16	14.64	.72	2.00	46.00	36.26	.90	13.00	41.59	16.06	1.99	2.77	35.09	72.66	14.18	3.23	9.93
17	15.00	.71	1.98	46.00	35.19	.90	14.00	41.46	15.83	2.13	2.99	35.05	71.73	13.16	3.50	11.61
18	15.35	.71	1.96	46.00	34.12	.90	15.00	41.33	15.60	2.27	3.20	35.01	70.80	12.14	3.76	13.30
19	13.71	.75	2.05	46.00	39.35	1.00	10.00	41.96	16.73	1.60	2.13	35.21	75.27	17.05	2.40	5.28
20	14.04	.74	2.03	46.00	38.29	1.00	11.00	41.83	16.50	1.74	2.34	35.17	74.34	16.03	2.67	6.96
21	14.34	.73	2.01	46.00	37.22	1.00	12.00	41.71	16.27	1.88	2.56	35.14	73.41	15.01	2.94	8.63
22	14.71	.73	2.00	46.00	36.15	1.00	13.00	41.58	16.04	2.01	2.77	35.10	72.49	13.99	3.21	10.31
23	15.04	.72	2.00	46.00	35.08	1.00	14.00	41.46	15.81	2.15	2.99	35.06	71.56	12.97	3.48	12.00
24	15.41	.71	1.98	46.00	34.02	1.00	15.00	41.33	15.57	2.29	3.20	35.02	70.63	11.95	3.75	13.68
25	13.77	.76	2.05	46.00	39.25	1.10	10.00	41.95	16.71	1.63	2.13	35.22	75.09	16.86	2.38	5.66
26	14.10	.75	2.03	46.00	38.18	1.10	11.00	41.83	16.48	1.76	2.34	35.18	74.17	15.84	2.65	7.34
27	14.44	.74	2.01	46.00	37.11	1.10	12.00	41.70	16.24	1.90	2.56	35.14	73.24	14.82	2.92	9.02
28	14.77	.74	2.00	46.00	36.05	1.10	13.00	41.58	16.01	2.04	2.77	35.10	72.31	13.80	3.19	10.70
29	15.12	.73	1.98	46.00	34.98	1.10	14.00	41.45	15.78	2.18	2.99	35.06	71.38	12.78	3.46	12.38
30	15.47	.72	1.96	46.00	33.91	1.10	15.00	41.32	15.55	2.31	3.20	35.02	70.45	11.75	3.73	14.06
31	13.82	.78	2.05	46.00	39.14	1.20	10.00	41.95	16.68	1.65	2.13	35.22	74.92	16.67	2.37	6.04
32	14.15	.76	2.03	46.00	38.08	1.20	11.00	41.82	16.45	1.79	2.34	35.18	73.99	15.65	2.63	7.72
33	14.49	.75	2.01	46.00	37.01	1.20	12.00	41.70	16.22	1.93	2.56	35.14	73.07	14.63	2.90	9.40
34	14.81	.74	2.00	46.00	35.94	1.20	13.00	41.57	15.99	2.06	2.77	35.10	72.14	13.61	3.17	11.08
35	15.14	.74	1.98	46.00	34.87	1.20	14.00	41.44	15.76	2.20	2.99	35.06	71.21	12.59	3.44	12.76

LSF	SM	AM	HM	C3S	C2S	C3A	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	SanS	IrmOr	Marl
615.57	2.80	.73	1.96	46.00	33.81	1.20	15.00	41.32	15.52	2.34	3.20	35.03	70.28	11.56	3.71	14.45
783.84	4.38	.79	2.05	46.00	39.04	1.30	10.00	41.94	16.66	1.68	2.13	35.22	74.75	16.48	2.35	6.43
784.21	3.95	.77	2.03	46.00	37.97	1.30	11.00	41.82	16.43	1.81	2.34	35.18	73.82	15.46	2.62	8.10
784.54	3.59	.76	2.01	46.00	36.90	1.30	12.00	41.69	16.19	1.95	2.56	35.15	72.89	14.44	2.88	9.78
784.80	3.28	.75	2.00	46.00	35.84	1.30	13.00	41.56	15.96	2.09	2.77	35.11	71.97	13.42	3.15	11.46
785.27	3.02	.75	1.98	46.00	34.77	1.30	14.00	41.44	15.73	2.23	2.99	35.07	71.04	12.40	3.42	13.15
785.50	2.78	.74	1.96	46.00	33.70	1.30	15.00	41.31	15.50	2.36	3.20	35.03	70.11	11.37	3.69	14.83
783.97	4.34	.80	2.05	46.00	38.93	1.40	10.00	41.94	16.63	1.70	2.13	35.23	74.57	16.29	2.33	6.81
784.24	3.92	.78	2.03	46.00	37.86	1.40	11.00	41.81	16.40	1.84	2.34	35.19	73.65	15.27	2.60	8.48
784.60	3.57	.77	2.01	46.00	36.80	1.40	12.00	41.68	16.17	1.98	2.56	35.15	72.72	14.25	2.87	10.16
784.94	3.26	.76	2.00	46.00	35.73	1.40	13.00	41.56	15.94	2.11	2.77	35.11	71.79	13.23	3.13	11.84
785.29	3.00	.75	1.98	46.00	34.66	1.40	14.00	41.43	15.71	2.25	2.99	35.07	70.86	12.21	3.40	13.53
785.64	2.77	.75	1.96	46.00	33.59	1.40	15.00	41.30	15.47	2.39	3.20	35.03	69.93	11.18	3.67	15.21
783.90	4.31	.81	2.05	46.00	38.83	1.50	10.00	41.93	16.61	1.73	2.13	35.23	74.40	16.10	2.31	7.19
784.37	3.89	.79	2.03	46.00	37.76	1.50	11.00	41.80	16.38	1.86	2.34	35.19	73.47	15.08	2.58	8.87
784.64	3.54	.78	2.01	46.00	36.69	1.50	12.00	41.68	16.15	2.00	2.56	35.15	72.55	14.06	2.85	10.55
785.00	3.24	.77	2.00	46.00	35.62	1.50	13.00	41.55	15.91	2.14	2.77	35.11	71.62	13.04	3.12	12.23
785.35	2.98	.76	1.98	46.00	34.56	1.50	14.00	41.42	15.68	2.27	2.99	35.07	70.69	12.01	3.39	13.91
785.70	2.75	.75	1.96	46.00	33.49	1.50	15.00	41.30	15.45	2.41	3.20	35.04	69.76	10.99	3.66	15.60
784.04	4.28	.82	2.05	46.00	38.72	1.60	10.00	41.92	16.58	1.75	2.13	35.23	74.23	15.91	2.29	7.57
784.34	3.87	.81	2.03	46.00	37.65	1.60	11.00	41.80	16.35	1.89	2.34	35.19	73.30	14.89	2.56	9.25
784.71	3.52	.79	2.01	46.00	36.59	1.60	12.00	41.67	16.12	2.02	2.56	35.16	72.37	13.87	2.83	10.93
785.04	3.22	.78	2.00	46.00	35.52	1.60	13.00	41.54	15.89	2.16	2.77	35.12	71.45	12.85	3.10	12.61
785.41	2.96	.77	1.98	46.00	34.45	1.60	14.00	41.42	15.66	2.30	2.99	35.08	70.52	11.82	3.37	14.29
785.76	2.74	.76	1.96	46.00	33.38	1.60	15.00	41.29	15.42	2.44	3.20	35.04	69.58	10.80	3.64	15.98
784.10	4.24	.83	2.05	46.00	38.62	1.70	10.00	41.92	16.56	1.77	2.13	35.24	74.05	15.72	2.28	7.95
784.47	3.84	.82	2.03	46.00	37.55	1.70	11.00	41.79	16.33	1.91	2.34	35.20	73.13	14.70	2.54	9.63
784.77	3.50	.80	2.01	46.00	36.48	1.70	12.00	41.66	16.10	2.05	2.56	35.16	72.20	13.68	2.81	11.31
785.17	3.20	.79	1.99	46.00	35.41	1.70	13.00	41.54	15.86	2.19	2.77	35.12	71.27	12.66	3.08	12.99
785.47	2.94	.78	1.98	46.00	34.35	1.70	14.00	41.41	15.63	2.32	2.99	35.08	70.34	11.63	3.35	14.68
785.87	2.72	.77	1.96	46.00	33.28	1.70	15.00	41.28	15.40	2.46	3.20	35.04	69.41	10.61	3.62	16.36
784.15	4.21	.85	2.05	46.00	38.51	1.80	10.00	41.91	16.53	1.80	2.13	35.24	73.88	15.53	2.26	8.34

LSF	SH	AM	HM	CS	CS	CSA	CAF	CaO	SiO2	Al2O3	FeO	LOI	LS	Sand	Ironore	Char
84.40	3.81	.83	2.03	46.00	37.44	1.80	11.00	41.78	16.30	1.79	2.34	35.20	72.95	14.51	4.53	10.01
84.99	3.47	.81	2.01	46.00	36.37	1.80	12.00	41.66	16.07	2.07	2.56	35.16	72.03	13.49	2.79	11.69
85.17	3.18	.80	1.99	46.00	35.31	1.80	13.00	41.53	15.84	2.21	2.77	35.12	71.10	12.46	3.06	13.37
85.57	2.93	.79	1.98	46.00	34.24	1.80	14.00	41.40	15.61	2.35	2.99	35.08	70.17	11.44	3.33	15.06
85.89	4.10	.78	1.96	46.00	33.17	1.80	15.00	41.28	15.37	2.49	3.20	35.05	69.24	10.42	3.60	16.74
84.21	3.78	.84	2.05	46.00	32.40	1.90	10.00	41.90	16.51	1.82	2.13	35.24	73.71	15.34	2.24	8.72
84.54	3.45	.82	2.05	46.00	31.34	1.90	11.00	41.78	16.28	1.96	2.34	35.20	72.78	14.32	2.51	10.40
84.89	3.16	.81	2.01	46.00	30.27	1.90	12.00	41.65	16.05	2.10	2.56	35.17	71.85	13.30	2.78	12.08
85.21	2.91	.79	1.99	46.00	29.20	1.90	13.00	41.52	15.81	2.23	2.77	35.13	70.93	12.27	3.04	13.76
85.58	2.69	.78	1.98	46.00	28.13	1.90	14.00	41.40	15.58	2.37	2.99	35.09	70.00	11.25	3.31	15.44
85.94	4.15	.87	1.96	46.00	27.07	1.90	15.00	41.27	15.35	2.51	3.20	35.05	69.06	10.23	3.58	17.13
84.27	3.76	.85	2.05	46.00	26.00	2.00	10.00	41.90	16.48	1.85	2.13	35.25	73.53	15.14	2.22	9.10
84.61	3.43	.83	2.03	46.00	25.23	2.00	11.00	41.77	16.25	1.98	2.34	35.21	72.61	14.13	2.49	10.78
84.94	3.14	.82	2.01	46.00	24.16	2.00	12.00	41.64	16.02	2.12	2.56	35.17	71.68	13.10	2.76	12.46
85.29	2.89	.80	1.99	46.00	23.10	2.00	13.00	41.52	15.79	2.26	2.77	35.13	70.75	12.08	3.03	14.14
85.64	2.67	.79	1.98	46.00	22.03	2.00	14.00	41.39	15.56	2.40	2.99	35.09	69.82	11.06	3.29	15.82
86.01	4.12	.88	1.96	46.00	21.96	2.00	15.00	41.26	15.33	2.53	3.20	35.05	68.89	10.04	3.56	17.51
84.39	3.73	.86	2.05	46.00	20.89	2.10	10.00	41.89	16.46	1.87	2.13	35.25	73.36	14.95	2.20	9.48
84.64	3.40	.84	2.03	46.00	20.13	2.10	11.00	41.76	16.23	2.01	2.34	35.21	72.43	13.93	2.47	11.16
85.00	3.12	.82	2.01	46.00	19.06	2.10	12.00	41.64	16.00	2.15	2.56	35.17	71.51	12.91	2.74	12.84
85.35	2.87	.81	1.99	46.00	18.00	2.10	13.00	41.51	15.77	2.28	2.77	35.13	70.58	11.89	3.01	14.52
85.70	2.66	.80	1.98	46.00	17.92	2.10	14.00	41.38	15.53	2.42	2.99	35.09	69.65	10.87	3.28	16.21
86.06	4.09	.89	1.96	46.00	16.86	2.10	15.00	41.26	15.30	2.56	3.20	35.06	68.72	9.85	3.55	17.89
84.38	3.70	.87	2.05	46.00	15.79	2.20	10.00	41.88	16.44	1.90	2.13	35.25	73.19	14.76	2.19	9.86
84.74	3.38	.85	2.03	46.00	14.72	2.20	11.00	41.76	16.20	2.03	2.34	35.22	72.26	13.74	2.45	11.54
85.09	3.10	.83	2.01	46.00	13.65	2.20	12.00	41.63	15.97	2.17	2.56	35.18	71.33	12.72	2.72	13.22
85.41	2.86	.82	1.99	46.00	12.58	2.20	13.00	41.50	15.74	2.31	2.77	35.14	70.41	11.70	2.99	14.90
85.74	2.64	.81	1.98	46.00	11.51	2.20	14.00	41.38	15.51	2.44	2.99	35.10	69.48	10.68	3.26	16.59
86.11	4.05	.90	1.96	46.00	10.44	2.20	15.00	41.25	15.28	2.58	3.20	35.06	68.54	9.65	3.53	18.27
84.41	3.68	.88	2.05	46.00	9.37	2.30	10.00	41.88	16.41	1.92	2.13	35.26	73.02	14.57	2.17	10.24
84.77	3.68	.88	2.03	46.00	8.30	2.30	11.00	41.75	16.18	2.06	2.34	35.22	72.09	13.55	2.43	11.92

	LSF	SH	AH	HM	G5	G5	G3A	G4F	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Iron oxide	Harl
9	85.17	3.36	.86	2.01	46.00	25.85	2.30	12.00	41.63	15.95	2.19	2.56	35.18	71.16	12.53	2.70	13.60
340	85.46	3.08	.84	1.99	46.00	34.78	2.30	13.00	41.50	15.72	2.33	2.77	35.14	70.23	11.51	2.97	15.29
1	85.87	2.84	.83	1.98	46.00	33.71	2.30	14.00	41.37	15.48	2.47	2.99	35.10	69.30	11.49	3.24	16.97
2	86.12	2.63	.81	1.96	46.00	32.64	2.30	15.00	41.25	15.25	2.61	3.20	35.06	68.37	11.46	3.51	18.66
3	84.40	4.02	.91	2.05	46.00	37.88	2.40	10.00	41.87	16.39	1.94	2.13	35.26	72.84	14.38	2.15	10.63
7	84.87	3.65	.89	2.03	46.00	36.81	2.40	11.00	41.74	16.15	2.08	2.34	35.22	71.92	13.36	2.42	12.90
6	85.17	3.34	.87	2.01	46.00	35.74	2.40	12.00	41.62	15.92	2.22	2.56	35.18	70.99	12.34	2.68	13.99
5	85.52	3.06	.85	1.99	46.00	34.67	2.40	13.00	41.49	15.69	2.49	2.77	35.14	70.06	11.32	2.95	15.67
8	85.82	2.82	.84	1.98	46.00	33.61	2.40	14.00	41.37	15.46	2.69	2.99	35.11	69.13	10.30	3.22	17.35
9	86.24	2.61	.82	1.96	46.00	32.54	2.40	15.00	41.24	15.23	2.89	3.20	35.07	68.20	9.27	3.49	19.04
7	86.55	3.99	.93	2.05	46.00	37.77	2.50	10.00	41.84	16.36	1.97	2.13	35.26	72.67	14.19	2.13	11.69
8	84.89	3.63	.90	2.03	46.00	36.70	2.50	11.00	41.74	16.13	2.11	2.34	35.23	71.74	13.17	2.40	12.69
2	85.23	3.31	.88	2.01	46.00	35.64	2.50	12.00	41.61	15.90	2.24	2.56	35.19	70.81	12.15	2.67	14.37
3	85.54	3.04	.86	1.98	46.00	34.57	2.50	13.00	41.49	15.67	2.38	2.77	35.15	69.89	11.13	2.94	16.05
4	86.30	2.60	.83	1.96	46.00	32.43	2.50	15.00	41.36	15.43	2.52	2.99	35.11	68.95	10.11	3.20	17.73
5	86.62	3.97	.94	2.05	46.00	37.66	2.60	10.00	41.86	16.34	1.99	2.13	35.27	72.50	14.00	2.11	11.39
6	84.94	3.60	.91	2.03	46.00	36.65	2.60	11.00	41.73	16.11	2.13	2.34	35.23	71.57	12.98	2.38	13.07
7	85.20	3.29	.89	2.01	46.00	35.53	2.60	12.00	41.61	15.87	2.27	2.56	35.19	70.64	11.96	2.65	14.75
8	86.44	3.02	.87	1.99	46.00	34.46	2.60	13.00	41.48	15.64	2.40	2.77	35.15	69.71	10.94	2.92	16.43
9	86.79	2.79	.85	1.98	46.00	33.39	2.60	14.00	41.35	15.41	2.54	2.99	35.11	68.78	9.92	3.19	18.12
1	86.34	2.58	.84	1.96	46.00	32.33	2.60	15.00	41.23	15.18	2.68	3.20	35.07	67.85	8.89	3.45	19.80
2	85.64	3.94	.95	2.05	46.00	37.56	2.70	10.00	41.85	16.31	2.02	2.13	35.27	72.32	13.81	2.09	11.77
3	85.07	3.58	.92	2.03	46.00	36.49	2.70	11.00	41.73	16.08	2.15	2.34	35.23	71.40	12.77	2.36	13.45
4	85.33	3.27	.90	2.01	46.00	35.42	2.70	12.00	41.60	15.85	2.29	2.56	35.19	70.47	11.77	2.63	15.13
5	85.77	3.00	.88	1.99	46.00	34.36	2.70	13.00	41.47	15.62	2.43	2.77	35.15	69.54	10.75	2.90	16.81
6	86.47	2.77	.86	1.97	46.00	33.29	2.70	14.00	41.35	15.38	2.57	2.98	35.12	68.61	9.73	3.17	18.50
7	84.77	3.91	.96	2.05	46.00	37.45	2.80	10.00	41.85	16.29	2.04	2.13	35.28	72.15	13.62	2.08	12.19
8	85.04	3.55	.93	2.03	46.00	36.39	2.80	11.00	41.72	16.06	2.18	2.34	35.24	71.22	12.60	2.34	13.83
9	85.44	3.25	.91	2.01	46.00	35.32	2.80	12.00	41.59	15.82	2.32	2.56	35.20	70.29	11.58	2.61	15.51
340	85.74	2.99	.89	1.99	46.00	34.25	2.80	13.00	41.47	15.59	2.45	2.77	35.16	69.37	10.56	2.88	17.20

LSF	SH	AM	HM	C3S	C2S	C3A	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Ironore	Wt%
1 86.11	2.75	.87	1.97	46.00	33.18	2.80	14.00	41.34	15.36	2.59	2.98	35.12	68.43	9.53	3.15	18.88
2 84.77	2.55	.85	1.94	46.00	32.12	2.80	15.00	41.21	15.13	2.73	3.20	35.08	67.50	8.51	3.42	20.57
3 84.77	3.88	.97	2.05	46.00	37.35	2.90	10.00	41.84	16.26	2.07	2.13	35.28	71.58	13.43	2.06	12.53
4 85.11	3.53	.94	2.03	46.00	36.28	2.90	11.00	41.71	16.03	2.20	2.34	35.24	71.05	12.41	2.33	14.21
5 85.44	3.23	.92	2.01	46.00	35.21	2.90	12.00	41.59	15.80	2.34	2.56	35.20	70.12	11.39	2.59	15.89
6 85.81	2.97	.89	1.99	46.00	34.15	2.90	13.00	41.46	15.57	2.48	2.77	35.16	69.19	10.37	2.86	17.58
7 86.17	2.74	.88	1.97	46.00	33.08	2.90	14.00	41.33	15.34	2.62	2.98	35.12	68.26	9.34	3.13	19.26
8 86.54	2.54	.86	1.96	46.00	32.01	2.90	15.00	41.21	15.10	2.72	3.20	35.08	67.33	8.32	3.40	20.95
9 84.83	3.85	.98	2.05	46.00	37.24	3.00	10.00	41.83	16.24	2.09	2.13	35.28	71.80	13.24	2.04	12.92
8 86.54	3.85	.98	2.05	46.00	37.24	3.00	10.00	41.83	16.24	2.09	2.13	35.28	71.80	13.24	2.04	12.92
9 85.17	3.50	.95	2.03	46.00	36.17	3.00	11.00	41.71	16.01	2.23	2.34	35.24	70.88	12.22	2.31	14.60
8 86.54	3.21	.93	2.01	46.00	35.11	3.00	12.00	41.58	15.77	2.36	2.56	35.20	69.95	11.20	2.58	16.28
1 85.87	2.95	.90	1.99	46.00	34.04	3.00	13.00	41.45	15.54	2.50	2.77	35.16	69.02	10.18	2.84	17.96
3 86.23	2.72	.88	1.97	46.00	32.97	3.00	14.00	41.33	15.31	2.64	2.99	35.12	68.09	9.15	3.11	19.65
4 86.60	2.52	.87	1.96	46.00	31.91	3.00	15.00	41.20	15.08	2.78	3.20	35.09	67.16	8.13	3.38	21.33
5 84.88	3.82	.99	2.04	46.00	37.14	3.10	10.00	41.83	16.21	2.11	2.13	35.28	71.63	13.05	2.02	13.30
6 85.23	3.48	.96	2.03	46.00	36.07	3.10	11.00	41.70	15.98	2.25	2.34	35.25	70.70	12.03	2.29	14.98
7 85.54	3.19	.94	2.01	46.00	35.00	3.10	12.00	41.57	15.75	2.39	2.55	35.21	69.78	11.01	2.56	16.66
8 86.29	2.93	.91	1.99	46.00	33.93	3.10	13.00	41.45	15.52	2.53	2.77	35.17	68.85	9.99	2.83	18.34
9 86.29	2.71	.89	1.97	46.00	32.87	3.10	14.00	41.32	15.29	2.66	2.98	35.13	67.92	8.96	3.09	20.03
9 86.64	2.51	.88	1.96	46.00	31.80	3.10	15.00	41.19	15.05	2.80	3.20	35.09	66.98	7.94	3.36	21.71
8 86.94	3.80	.90	2.04	46.00	37.03	3.20	10.00	41.82	16.19	2.14	2.13	35.29	71.46	12.86	2.00	13.68
2 85.29	3.46	.97	2.03	46.00	35.96	3.20	11.00	41.69	15.96	2.28	2.34	35.25	70.53	11.84	2.27	15.36
3 85.64	3.17	.94	2.01	46.00	34.90	3.20	12.00	41.57	15.73	2.41	2.55	35.21	69.60	10.82	2.54	17.04
4 85.99	2.91	.92	1.99	46.00	33.83	3.20	13.00	41.44	15.49	2.55	2.77	35.17	68.67	9.80	2.81	18.72
5 86.35	2.69	.90	1.96	46.00	32.76	3.20	14.00	41.31	15.26	2.69	2.98	35.13	67.74	8.77	3.08	20.41
6 86.72	2.49	.88	1.94	46.00	31.69	3.20	15.00	41.18	15.03	2.83	3.20	35.09	66.81	7.75	3.35	22.10
7 85.06	3.77	1.02	2.04	46.00	36.93	3.30	10.00	41.81	16.16	2.16	2.13	35.29	71.28	12.67	1.99	14.06
8 85.34	3.43	.98	2.03	46.00	35.86	3.30	11.00	41.69	15.93	2.30	2.34	35.25	70.36	11.65	2.25	15.74
9 85.69	3.15	.95	2.01	46.00	34.79	3.30	12.00	41.56	15.70	2.44	2.55	35.21	69.43	10.63	2.52	17.42
8 86.05	2.89	.93	1.99	46.00	33.72	3.30	13.00	41.43	15.47	2.57	2.77	35.17	68.50	9.61	2.79	19.11
9 86.41	2.67	.91	1.97	46.00	32.66	3.30	14.00	41.31	15.24	2.71	2.98	35.14	67.57	8.58	3.06	20.79

Sand Ironore Wt%

LSF	SH	AM	HH	C3S	C2S	C3A	C4AF	CAO	SiO2	Al2O3	Fe2O3	LOI	LS	Sand	Iron Ore	Harl
2 R6.7M	2.48	.89	1.96	46.00	31.59	3.30	15.00	41.18	15.00	2.85	3.20	35.10	66.64	7.56	3.33	22.48
3 R5.0A	3.74	1.03	2.04	46.00	36.82	3.40	10.00	41.81	16.14	2.19	2.13	35.29	71.11	12.48	1.97	14.44
4 R5.4N	3.41	.99	2.03	46.00	35.75	3.40	11.00	41.68	15.91	2.32	2.34	35.26	70.18	11.46	2.24	16.12
5 R5.7E	3.12	.96	2.01	46.00	34.68	3.40	12.00	41.55	15.68	2.46	2.55	35.22	69.26	10.44	2.50	17.80
6 R6.11	2.88	.94	1.99	46.00	33.62	3.40	13.00	41.43	15.44	2.60	2.77	35.18	68.33	9.91	2.77	19.49
7 R6.47	2.66	.92	1.97	46.00	32.55	3.40	14.00	41.30	15.21	2.74	2.98	35.14	67.40	8.39	3.04	21.17
8 R6.84	2.47	.90	1.96	46.00	31.48	3.40	15.00	41.17	14.98	2.87	3.20	35.10	66.46	7.37	3.31	22.86
9 R5.11	3.71	1.04	2.04	46.00	36.71	3.50	10.00	41.80	16.11	2.21	2.13	35.30	70.94	12.29	1.95	14.82
1 R5.4A	3.39	1.00	2.03	46.00	35.65	3.50	11.00	41.67	15.88	2.35	2.34	35.26	70.01	11.27	2.22	16.50
2 R6.17	3.11	.97	2.01	46.00	34.58	3.50	12.00	41.55	15.65	2.49	2.55	35.22	69.08	10.25	2.49	18.18
3 R6.53	2.86	.95	1.99	46.00	33.51	3.50	13.00	41.42	15.42	2.62	2.77	35.18	68.15	9.22	2.75	19.87
4 R6.90	2.45	.91	1.96	46.00	32.44	3.50	14.00	41.30	15.19	2.76	2.98	35.14	67.22	8.20	3.02	21.55
								41.17	14.95	2.90	3.20	35.10	66.29	7.18	3.29	23.24

Annex II

COMPUTERIZED RAW MIXES: GROUP B
(Percentage)

Selected values

Raw materials used

	From	To	% increase per step	Chemical analysis					Designation	Source
				CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI		
C ₃ S	40.0	46.0	2.00	26.32	33.31	8.50	3.60	24.85	Marl (X ₁)	Hawari quarry
C ₃ A	0.0	3.5	.10	53.76	.04	.00	.20	43.95	Limestone (X ₂)	Hawari quarry
C ₄ AF	10.0	15.0	1.00	13.44	69.69	1.88	.40	12.20	Sand (X ₃)	Gialo area
				1.40	13.37	11.60	62.40	10.09	Iron ore (X ₄)	Galmoya area

Raw mix no.	LSF	SH	AH	HM	C3S	C2S	C3A	C4AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	X1	X2	X3	X4
1	0.99	4.97	.64	2.00	40.00	46.61	.00	10.00	41.89	17.41	1.36	2.14	35.00	7.91	68.82	20.66	2.61
2	0.27	4.46	.64	1.99	40.00	45.59	.00	11.00	41.78	17.18	1.50	2.35	34.97	9.39	68.15	19.57	2.88
3	0.54	4.03	.64	1.97	40.00	44.57	.00	12.00	41.67	16.96	1.64	2.57	34.93	10.88	67.48	18.49	3.15
4	0.81	3.67	.64	1.95	40.00	43.55	.00	13.00	41.56	16.74	1.78	2.78	34.90	12.37	66.80	17.41	3.42
5	1.07	3.36	.64	1.93	40.00	42.53	.00	14.00	41.44	16.51	1.91	3.00	34.87	13.86	66.13	16.32	3.69
6	1.34	3.10	.64	1.92	40.00	41.51	.00	15.00	41.33	16.29	2.05	3.21	34.84	15.36	65.45	15.24	3.95
7	1.61	4.93	.65	2.00	40.00	46.50	.10	10.00	41.89	17.38	1.39	2.14	35.00	8.27	68.69	20.45	2.59
8	1.37	4.43	.65	1.99	40.00	45.48	.10	11.00	41.77	17.16	1.53	2.35	34.97	9.75	68.01	19.37	2.86
9	1.10	4.01	.65	1.97	40.00	44.46	.10	12.00	41.66	16.93	1.66	2.57	34.94	11.24	67.34	18.29	3.13
10	0.92	3.65	.65	1.95	40.00	43.44	.10	13.00	41.55	16.71	1.80	2.78	34.91	12.73	66.67	17.20	3.40
11	0.27	3.34	.65	1.93	40.00	42.42	.10	14.00	41.44	16.49	1.94	3.00	34.87	14.22	65.99	16.12	3.67
12	0.53	3.08	.65	1.92	40.00	41.40	.10	15.00	41.33	16.26	2.07	3.21	34.84	15.72	65.32	15.03	3.93
13	0.80	4.89	.66	2.00	40.00	46.39	.20	10.00	41.88	17.36	1.41	2.14	35.00	8.62	68.55	20.25	2.58
14	0.37	4.39	.66	1.99	40.00	45.37	.20	11.00	41.77	17.13	1.55	2.35	34.97	10.11	67.88	19.17	2.84
15	0.67	3.98	.66	1.97	40.00	44.35	.20	12.00	41.66	16.91	1.69	2.57	34.94	11.60	67.20	18.08	3.11
16	0.97	3.62	.66	1.95	40.00	43.33	.20	13.00	41.54	16.69	1.82	2.78	34.91	13.09	66.53	17.00	3.38
17	1.27	3.32	.65	1.93	40.00	42.31	.20	14.00	41.43	16.46	1.96	3.00	34.88	14.58	65.86	15.92	3.65
18	1.54	3.06	.65	1.92	40.00	41.29	.20	15.00	41.32	16.24	2.10	3.21	34.85	16.08	65.18	14.83	3.92
19	1.13	4.85	.67	2.00	40.00	46.29	.30	10.00	41.87	17.33	1.44	2.14	35.00	8.98	68.41	20.05	2.56
20	0.42	4.36	.67	1.99	40.00	45.27	.30	11.00	41.76	17.11	1.57	2.35	34.97	10.47	67.74	18.96	2.82
1	0.72	3.95	.67	1.97	40.00	44.25	.30	12.00	41.65	16.89	1.71	2.57	34.94	11.96	67.07	17.88	3.09
2	0.02	3.60	.66	1.95	40.00	43.23	.30	13.00	41.54	16.66	1.85	2.78	34.91	13.45	66.39	16.80	3.36
3	0.31	3.30	.66	1.93	40.00	42.21	.30	14.00	41.43	16.44	1.99	3.00	34.88	14.94	65.72	15.71	3.63
4	0.64	3.04	.66	1.92	40.00	41.19	.30	15.00	41.31	16.21	2.12	3.21	34.85	16.43	65.04	14.63	3.90
5	0.14	4.81	.68	2.00	40.00	46.18	.40	10.00	41.87	17.31	1.46	2.14	35.01	9.34	68.28	19.84	2.54

	LSF	SH	AM	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO
6	81.4A	4.33	.68	1.99	40.00	45.16	.40	11.00	41.76
7	81.7A	3.92	.68	1.97	40.00	44.14	.40	12.00	41.64
8	82.0A	3.58	.67	1.95	40.00	43.12	.40	13.00	41.53
9	82.3A	3.28	.67	1.93	40.00	42.10	.40	14.00	41.42
30	82.6A	3.02	.67	1.92	40.00	41.08	.40	15.00	41.31
1	81.2A	4.77	.70	2.00	40.00	46.07	.50	10.00	41.86
2	81.5A	4.29	.69	1.99	40.00	45.05	.50	11.00	41.75
3	81.8A	3.89	.69	1.97	40.00	44.03	.50	12.00	41.64
4	82.1A	3.55	.68	1.95	40.00	43.01	.50	13.00	41.52
5	82.4A	3.26	.68	1.93	40.00	41.99	.50	14.00	41.41
6	82.7A	3.00	.68	1.92	40.00	40.97	.50	15.00	41.30
7	81.2A	4.73	.71	2.00	40.00	45.97	.60	10.00	41.85
8	81.5A	4.26	.70	1.98	40.00	44.95	.60	11.00	41.74
9	81.8A	3.86	.70	1.97	40.00	43.93	.60	12.00	41.63
40	82.1A	3.53	.69	1.95	40.00	42.91	.60	13.00	41.52
1	82.4A	3.24	.69	1.93	40.00	41.89	.60	14.00	41.41
2	82.7A	2.98	.68	1.92	40.00	40.86	.60	15.00	41.29
3	81.3A	4.69	.72	2.00	40.00	45.86	.70	10.00	41.85
4	81.6A	4.23	.71	1.98	40.00	44.84	.70	11.00	41.74
5	81.9A	3.84	.71	1.97	40.00	43.82	.70	12.00	41.62
6	82.2A	3.50	.70	1.95	40.00	42.80	.70	13.00	41.51
7	82.5A	3.22	.70	1.93	40.00	41.78	.70	14.00	41.40
8	82.8A	2.97	.69	1.92	40.00	40.76	.70	15.00	41.29
9	81.3A	4.66	.73	2.00	40.00	45.75	.80	10.00	41.84
50	81.6A	4.20	.72	1.98	40.00	44.73	.80	11.00	41.73
1	81.9A	3.81	.71	1.97	40.00	43.71	.80	12.00	41.62
2	82.2A	3.48	.71	1.95	40.00	42.69	.80	13.00	41.51
3	82.6A	3.20	.70	1.93	40.00	41.67	.80	14.00	41.39
4	82.9A	2.95	.70	1.92	40.00	40.65	.80	15.00	41.28
5	81.4A	4.62	.74	2.00	40.00	45.65	.90	10.00	41.84
6	81.7A	4.17	.73	1.98	40.00	44.63	.90	11.00	41.72
7	82.0A	3.78	.72	1.97	40.00	43.61	.90	12.00	41.61
8	82.3A	3.46	.72	1.95	40.00	42.59	.90	13.00	41.50
9	82.6A	3.18	.71	1.93	40.00	41.56	.90	14.00	41.39
60	82.9A	2.93	.71	1.92	40.00	40.54	.90	15.00	41.27

SrO_2	Al_2O_3	Fe_2O_3	LOI	Marl	LS	Sand	Iron Ore
17.08	1.60	2.35	34.98	10.83	67.60	18.76	2.80
16.86	1.74	2.57	34.94	12.32	66.93	17.68	3.07
16.64	1.87	2.78	34.91	13.81	66.26	16.59	3.34
16.41	2.01	3.00	34.88	15.30	65.58	15.51	3.61
16.19	2.15	3.21	34.85	16.79	64.91	14.42	3.88
17.28	1.49	2.14	35.01	9.70	68.14	19.64	2.52
17.06	1.42	2.35	34.98	11.19	67.47	18.56	2.79
6.84	1.76	2.57	34.95	12.68	66.80	17.47	3.05
6.61	1.90	2.78	34.92	14.17	66.12	16.39	3.32
6.39	2.04	3.00	34.88	15.66	65.45	15.30	3.59
6.16	2.17	3.21	34.85	17.15	64.77	14.22	3.86
7.26	1.51	2.14	35.01	10.06	68.01	19.44	2.50
7.03	1.65	2.35	34.98	11.55	67.33	18.35	2.77
6.81	1.78	2.57	34.95	13.04	66.66	17.27	3.03
6.59	1.92	2.78	34.92	14.53	65.98	16.19	3.30
6.36	2.06	3.00	34.89	16.02	65.31	15.10	3.57
6.14	2.20	3.21	34.86	17.51	64.63	14.01	3.84
7.23	1.53	2.14	35.01	10.42	67.87	19.23	2.48
7.01	1.67	2.35	34.98	11.91	67.20	18.15	2.75
6.79	1.81	2.56	34.95	13.40	66.52	17.07	3.02
6.56	1.95	2.78	34.92	14.89	65.85	15.98	3.28
6.34	2.08	3.00	34.89	16.38	65.17	14.90	3.55
6.11	2.22	3.21	34.86	17.87	64.50	13.81	3.82
7.21	1.56	2.14	35.02	10.78	67.73	19.03	2.46
6.98	1.70	2.35	34.99	12.27	67.06	17.95	2.73
6.76	1.83	2.56	34.95	13.76	66.39	16.86	3.00
6.54	1.97	2.78	34.92	15.25	65.71	15.78	3.26
6.31	2.11	3.00	34.89	16.74	65.04	14.69	3.53
6.09	2.25	3.21	34.86	18.23	64.36	13.61	3.80
7.18	1.58	2.14	35.02	11.14	67.60	18.82	2.44
6.96	1.72	2.35	34.99	12.62	66.92	17.74	2.71
6.74	1.86	2.56	34.96	14.11	66.25	16.66	2.98
6.51	2.00	2.78	34.93	15.61	65.58	15.57	3.24
6.29	2.13	3.00	34.89	17.10	64.90	14.49	3.51
6.06	2.27	3.21	34.86	18.59	64.22	13.40	3.78

LSF	SH	AM	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Harl	LS	SaO	Iron Ore
181.50	4.58	.75	2.00	40.00	45.54	1.00	10.00	41.83	17.16	1.81	2.14	35.02	11.50	67.70	15.02	2.72
281.79	4.14	.74	1.98	40.00	44.52	1.00	11.00	41.72	16.93	1.75	2.35	34.99	12.98	66.179	17.54	2.69
382.10	3.76	.73	1.97	40.00	43.50	1.00	12.00	41.61	16.71	1.88	2.56	34.96	14.47	66.144	16.46	2.96
482.40	3.43	.73	1.95	40.00	42.48	1.00	13.00	41.49	16.49	2.02	2.78	34.93	15.96	65.144	15.37	3.23
582.71	3.16	.72	1.93	40.00	41.46	1.00	14.00	41.38	16.26	2.16	3.00	34.90	17.46	64.176	14.29	3.49
683.03	2.91	.71	1.92	40.00	40.44	1.00	15.00	41.27	16.04	2.30	3.21	34.87	18.95	64.09	13.20	3.76
781.55	4.55	.76	2.00	40.00	45.43	1.10	10.00	41.82	17.13	1.63	2.14	35.02	11.85	67.32	18.42	2.40
881.85	4.10	.75	1.98	40.00	44.41	1.10	11.00	41.71	16.91	1.77	2.35	34.99	13.34	66.165	17.34	2.67
982.15	3.73	.74	1.97	40.00	43.39	1.10	12.00	41.60	16.69	1.91	2.56	34.96	14.83	65.198	16.25	2.94
1082.46	3.41	.74	1.95	40.00	42.37	1.10	13.00	41.49	16.46	2.04	2.78	34.93	16.32	65.30	15.17	3.21
1182.77	3.14	.73	1.93	40.00	41.35	1.10	14.00	41.37	16.24	2.18	2.99	34.90	17.82	64.163	14.08	3.47
1283.06	2.90	.72	1.92	40.00	40.33	1.10	15.00	41.26	16.01	2.32	3.21	34.87	19.31	63.195	13.00	3.74
1381.60	4.51	.78	2.00	40.00	45.33	1.20	10.00	41.82	17.11	1.66	2.14	35.03	12.21	67.19	18.21	2.38
1481.90	4.07	.76	1.98	40.00	44.30	1.20	11.00	41.70	16.88	1.79	2.35	35.00	13.70	66.51	17.13	2.65
1582.20	3.71	.75	1.97	40.00	43.28	1.20	12.00	41.59	16.66	1.93	2.56	34.96	15.19	65.184	16.05	2.92
1682.51	3.39	.74	1.95	40.00	42.26	1.20	13.00	41.48	16.44	2.07	2.78	34.93	16.68	65.17	14.96	3.19
1782.80	3.12	.74	1.93	40.00	41.24	1.20	14.00	41.37	16.21	2.21	2.99	34.90	18.18	64.149	13.88	3.46
1883.14	2.88	.73	1.91	40.00	40.22	1.20	15.00	41.26	15.99	2.34	3.21	34.87	19.67	63.182	12.79	3.72
1981.65	4.48	.79	2.00	40.00	45.22	1.30	10.00	41.81	17.08	1.68	2.13	35.03	12.57	67.05	18.01	2.37
2081.95	4.04	.77	1.98	40.00	44.20	1.30	11.00	41.70	16.86	1.82	2.35	35.00	14.06	66.138	16.93	2.63
2182.26	3.68	.76	1.97	40.00	43.18	1.30	12.00	41.59	16.64	1.96	2.56	34.97	15.55	65.170	15.84	2.90
2282.56	3.37	.75	1.95	40.00	42.16	1.30	13.00	41.47	16.41	2.09	2.78	34.94	17.04	65.03	14.76	3.17
2382.84	3.10	.75	1.93	40.00	41.14	1.30	14.00	41.36	16.19	2.23	2.99	34.90	18.53	64.136	13.67	3.44
2483.19	2.86	.74	1.91	40.00	40.12	1.30	15.00	41.25	15.96	2.37	3.21	34.87	20.03	63.168	12.59	3.70
2581.71	4.44	.80	2.00	40.00	45.11	1.40	10.00	41.80	17.06	1.71	2.13	35.03	12.93	66.192	17.81	2.35
2682.01	4.02	.78	1.98	40.00	44.09	1.40	11.00	41.69	16.83	1.84	2.35	35.00	14.42	66.124	16.72	2.61
2782.31	3.65	.77	1.97	40.00	43.07	1.40	12.00	41.58	16.61	1.98	2.56	34.97	15.91	65.157	15.64	2.88
2882.62	3.35	.76	1.95	40.00	42.05	1.40	13.00	41.47	16.39	2.12	2.78	34.94	17.40	64.189	14.56	3.15
2982.93	3.08	.75	1.93	40.00	41.03	1.40	14.00	41.36	16.16	2.26	2.99	34.91	18.89	64.122	13.47	3.42
3083.25	2.84	.75	1.91	40.00	40.01	1.40	15.00	41.24	15.94	2.39	3.21	34.88	20.39	63.154	12.38	3.68
3181.78	4.41	.81	2.00	40.00	45.00	1.50	10.00	41.80	17.03	1.73	2.13	35.03	13.29	66.178	17.60	2.33
3282.08	3.99	.79	1.98	40.00	43.98	1.50	11.00	41.68	16.81	1.87	2.35	35.00	14.78	66.11	16.52	2.59
3382.38	3.63	.78	1.97	40.00	42.96	1.50	12.00	41.57	16.59	2.00	2.56	34.97	16.27	65.143	15.44	2.86
3482.67	3.32	.77	1.95	40.00	41.94	1.50	13.00	41.46	16.36	2.14	2.78	34.94	17.76	64.176	14.35	3.13
3582.99	3.06	.76	1.93	40.00	40.92	1.50	14.00	41.35	16.14	2.28	2.99	34.91	19.25	64.108	13.27	3.40

LSF	SM	AH	HH	CS	CS	CS	CA	CAF	CaO	SiO2	Al2O3	Fe2O3	LOI	Harl	LS	Sand	Impore
683.37	2.83	.75	1.91	40.00	39.90	1.50	15.00	41.24	15.91	2.42	3.21	34.88	20.75	63.41	12.18	3.67	
781.81	4.37	.82	2.00	40.00	44.90	1.60	10.00	41.79	17.01	1.75	2.13	35.04	13.65	66.64	17.40	2.31	
822.11	3.96	.81	1.98	40.00	43.88	1.60	11.00	41.68	16.78	1.89	2.35	35.01	15.14	65.97	16.32	2.58	
822.49	3.61	.79	1.96	40.00	42.46	1.60	12.00	41.57	16.56	2.03	2.56	34.97	16.63	65.30	15.23	2.84	
822.79	3.30	.78	1.95	40.00	41.84	1.60	13.00	41.45	16.34	2.17	2.78	34.94	18.12	64.62	14.15	3.11	
822.84	3.04	.77	1.93	40.00	40.82	1.60	14.00	41.34	16.11	2.30	2.99	34.91	19.61	63.95	13.06	3.38	
822.84	2.81	.76	1.91	40.00	39.80	1.60	15.00	41.23	15.89	2.44	3.21	34.88	21.11	63.27	11.98	3.65	
822.87	4.34	.83	2.00	40.00	44.79	1.70	10.00	41.78	16.98	1.78	2.13	35.04	14.01	66.51	17.20	2.29	
822.17	3.93	.82	1.98	40.00	43.77	1.70	11.00	41.67	16.76	1.92	2.35	35.01	15.49	65.83	16.11	2.56	
822.47	3.58	.80	1.96	40.00	42.75	1.70	12.00	41.56	16.54	2.05	2.50	34.98	16.99	65.16	15.03	2.82	
822.78	3.28	.79	1.95	40.00	41.73	1.70	13.00	41.45	16.31	2.19	2.78	34.95	18.48	64.49	13.95	3.09	
822.19	3.02	.78	1.93	40.00	40.71	1.70	14.00	41.34	16.09	2.33	2.99	34.92	19.97	63.81	12.86	3.36	
822.49	2.80	.77	1.91	40.00	39.69	1.70	15.00	41.22	15.87	2.47	3.21	34.88	21.47	63.13	11.77	3.63	
822.99	4.31	.85	2.00	40.00	44.68	1.80	10.00	41.78	16.96	1.80	2.13	35.04	14.36	66.13	16.99	2.27	
822.29	3.90	.83	1.98	40.00	43.66	1.80	11.00	41.67	16.73	1.94	2.35	35.01	15.85	65.70	15.91	2.54	
822.84	3.26	.80	1.96	40.00	42.64	1.80	12.00	41.55	16.51	2.08	2.56	34.98	17.34	65.02	14.83	2.80	
822.15	3.00	.79	1.95	40.00	41.62	1.80	13.00	41.44	16.29	2.22	2.78	34.95	18.84	64.35	13.74	3.07	
822.47	3.00	.78	1.93	40.00	40.60	1.80	14.00	41.33	16.06	2.35	2.99	34.92	20.33	63.67	12.66	3.34	
822.97	2.72	.78	1.91	40.00	39.58	1.80	15.00	41.22	15.84	2.49	3.21	34.89	21.82	63.00	11.57	3.61	
822.27	3.87	.86	2.00	40.00	43.56	1.90	10.00	41.77	16.93	1.83	2.13	35.04	14.72	66.23	16.79	2.25	
822.84	3.53	.84	1.98	40.00	42.54	1.90	11.00	41.66	16.71	1.97	2.35	35.01	16.21	65.56	15.71	2.52	
822.84	3.24	.82	1.96	40.00	41.52	1.90	12.00	41.55	16.49	2.10	2.56	34.98	17.70	64.89	14.62	2.79	
822.21	2.99	.81	1.95	40.00	40.50	1.90	13.00	41.44	16.26	2.24	2.78	34.95	19.19	64.21	13.54	3.05	
822.52	4.24	.79	1.93	40.00	39.48	1.90	14.00	41.32	16.04	2.38	2.99	34.92	20.69	63.54	12.45	3.32	
822.84	4.76	.78	1.91	40.00	38.46	1.90	15.00	41.21	15.82	2.52	3.21	34.89	22.18	62.86	11.37	3.59	
822.84	3.85	.87	2.00	40.00	43.45	2.00	10.00	41.76	16.91	1.85	2.13	35.05	15.08	66.10	16.59	2.23	
822.37	3.85	.85	1.98	40.00	42.43	2.00	11.00	41.65	16.69	1.99	2.35	35.02	16.57	65.43	15.50	2.50	
822.64	3.51	.83	1.96	40.00	41.41	2.00	12.00	41.54	16.46	2.13	2.56	34.98	18.06	64.75	14.42	2.77	
822.95	3.22	.82	1.95	40.00	40.39	2.00	13.00	41.43	16.24	2.26	2.78	34.95	19.55	64.08	13.34	3.03	
822.26	2.97	.80	1.93	40.00	39.37	2.00	14.00	41.32	16.01	2.40	2.99	34.92	21.05	63.40	12.25	3.30	
822.58	2.75	.79	1.91	40.00	38.35	2.00	15.00	41.20	15.79	2.54	3.21	34.89	22.54	62.73	11.16	3.57	

LSF	SH	AH	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Marl	LS	Sand	Irm dre
182.3A	4.21	.88	2.00	40.00	44.36	2.10	10.00	41.76	16.88	1.88	2.13	35.05	15.44	65.96	16.38	2.21
182.3B	3.82	.86	1.98	40.00	43.34	2.10	11.00	41.65	16.66	2.01	2.35	35.02	16.93	65.29	15.30	2.48
182.6A	3.49	.84	1.96	40.00	42.32	2.10	12.00	41.53	16.44	2.15	2.56	34.99	18.42	64.62	14.22	2.75
183.2A	3.20	.82	1.95	40.00	41.30	2.10	13.00	41.42	16.21	2.29	2.78	34.96	19.91	63.94	13.13	3.01
183.2B	2.95	.81	1.93	40.00	40.28	2.10	14.00	41.31	15.99	2.43	2.99	34.93	21.41	63.26	12.05	3.28
183.6A	2.73	.80	1.91	40.00	39.26	2.10	15.00	41.20	15.77	2.56	3.21	34.89	22.90	62.59	10.96	3.55
182.1A	4.18	.89	2.00	40.00	44.26	2.20	10.00	41.75	16.86	1.90	2.13	35.05	15.80	65.83	16.18	2.19
182.4A	3.79	.87	1.98	40.00	43.24	2.20	11.00	41.64	16.64	2.04	2.35	35.02	17.29	65.15	15.10	2.46
182.75	3.46	.85	1.96	40.00	42.22	2.20	12.00	41.53	16.41	2.18	2.56	34.99	18.78	64.48	14.01	2.73
183.0A	3.18	.83	1.95	40.00	41.20	2.20	13.00	41.42	16.19	2.31	2.78	34.96	20.27	63.80	12.93	3.00
183.3A	2.93	.82	1.93	40.00	40.17	2.20	14.00	41.30	15.96	2.45	2.99	34.93	21.76	63.13	11.84	3.26
183.7A	2.71	.81	1.91	40.00	39.15	2.20	15.00	41.19	15.74	2.59	3.21	34.90	23.26	62.45	10.76	3.53
182.1B	4.15	.90	2.00	40.00	44.15	2.30	10.00	41.75	16.83	1.93	2.13	35.05	16.16	65.69	15.98	2.17
182.4B	3.76	.88	1.98	40.00	43.13	2.30	11.00	41.63	16.61	2.06	2.35	35.02	17.65	65.02	14.89	2.44
182.8A	3.44	.86	1.96	40.00	42.11	2.30	12.00	41.52	16.39	2.20	2.56	34.99	19.14	64.34	13.81	2.71
183.1A	3.16	.84	1.95	40.00	41.09	2.30	13.00	41.41	16.16	2.34	2.78	34.96	20.63	63.67	12.73	2.98
183.4A	2.91	.83	1.93	40.00	40.07	2.30	14.00	41.30	15.94	2.48	2.99	34.93	22.12	62.99	11.64	3.24
183.75	2.70	.81	1.91	40.00	39.05	2.30	15.00	41.19	15.72	2.61	3.21	34.90	23.62	62.32	10.55	3.51
182.2A	4.12	.91	2.00	40.00	44.04	2.40	10.00	41.74	16.81	1.95	2.13	35.06	16.52	65.55	15.77	2.16
182.5A	3.74	.89	1.98	40.00	43.02	2.40	11.00	41.63	16.59	2.09	2.35	35.03	18.00	64.88	14.69	2.42
182.85	3.42	.87	1.96	40.00	42.00	2.40	12.00	41.52	16.36	2.23	2.56	35.00	19.50	64.21	13.61	2.67
183.1A	3.14	.85	1.95	40.00	40.98	2.40	13.00	41.40	16.14	2.36	2.78	34.96	20.99	63.53	12.52	2.96
183.4A	2.90	.84	1.93	40.00	39.96	2.40	14.00	41.29	15.91	2.50	2.99	34.93	22.48	62.86	11.44	3.23
183.8A	2.68	.82	1.91	40.00	38.94	2.40	15.00	41.18	15.69	2.64	3.21	34.90	23.98	62.18	10.35	3.49
182.2B	4.08	.93	2.00	40.00	43.94	2.50	10.00	41.73	16.78	1.97	2.13	35.06	16.87	65.42	15.57	2.14
182.6B	3.71	.90	1.98	40.00	42.92	2.50	11.00	41.62	16.56	2.11	2.35	35.03	18.36	64.74	14.49	2.40
182.9A	3.39	.88	1.96	40.00	41.89	2.50	12.00	41.51	16.34	2.25	2.56	35.00	19.85	64.07	13.40	2.67
183.2A	3.12	.86	1.95	40.00	40.87	2.50	13.00	41.40	16.11	2.39	2.78	34.97	21.35	63.40	12.32	2.94
183.5A	2.88	.84	1.93	40.00	39.85	2.50	14.00	41.28	15.89	2.52	2.99	34.94	22.84	62.72	11.23	3.21
183.8A	2.67	.83	1.91	40.00	38.83	2.50	15.00	41.17	15.67	2.66	3.21	34.90	24.34	62.04	10.15	3.47
182.3A	4.05	.94	2.00	40.00	43.83	2.60	10.00	41.73	16.76	2.00	2.13	35.06	17.23	65.28	15.37	2.12
182.6A	3.69	.91	1.98	40.00	42.81	2.60	11.00	41.61	16.54	2.14	2.35	35.03	18.72	64.61	14.28	2.38

	LSF	SH	AM	HH	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	C ₂ O
4	82.9A	3.37	.89	1.96	40.00	41.79	2.60	12.00	41.50
160	83.2A	3.10	.87	1.95	40.00	40.77	2.60	13.00	41.39
1	83.6A	2.86	.85	1.93	40.00	39.75	2.60	14.00	41.28
2	83.9A	2.65	.84	1.91	40.00	38.73	2.60	15.00	41.17
3	82.4A	4.03	.95	2.00	40.00	43.72	2.70	10.00	41.72
4	82.7A	3.66	.92	1.98	40.00	42.70	2.70	11.00	41.61
5	83.0A	3.35	.90	1.96	40.00	41.68	2.70	12.00	41.50
6	83.3A	3.08	.88	1.94	40.00	40.66	2.70	13.00	41.38
7	83.6A	2.85	.86	1.93	40.00	39.64	2.70	14.00	41.27
8	83.98	2.64	.85	1.91	40.00	38.62	2.70	15.00	41.16
9	82.4E	4.00	.96	2.00	40.00	43.61	2.80	10.00	41.71
170	82.7A	3.64	.93	1.98	40.00	42.59	2.80	11.00	41.60
1	83.0A	3.33	.91	1.96	40.00	41.57	2.80	12.00	41.49
2	83.30	3.06	.89	1.94	40.00	40.55	2.80	13.00	41.38
3	83.71	2.83	.87	1.93	40.00	39.53	2.80	14.00	41.27
4	84.0A	2.62	.85	1.91	40.00	38.51	2.80	15.00	41.15
5	82.51	3.97	.97	2.00	40.00	43.51	2.90	10.00	41.71
6	82.8A	3.61	.94	1.98	40.00	42.49	2.90	11.00	41.60
7	83.1A	3.31	.92	1.96	40.00	41.47	2.90	12.00	41.48
8	83.4E	3.04	.89	1.94	40.00	40.45	2.90	13.00	41.37
9	83.7A	2.81	.88	1.93	40.00	39.43	2.90	14.00	41.26
180	84.10	2.61	.86	1.91	40.00	38.41	2.90	15.00	41.15
1	82.5A	3.94	.98	2.00	40.00	43.40	3.00	10.00	41.70
2	82.8A	3.59	.95	1.98	40.00	42.38	3.00	11.00	41.59
3	83.1A	3.29	.93	1.96	40.00	41.36	3.00	12.00	41.48
4	83.50	3.02	.90	1.94	40.00	40.34	3.00	13.00	41.36
5	83.8A	2.80	.88	1.93	40.00	39.32	3.00	14.00	41.25
6	84.1E	2.59	.87	1.91	40.00	38.30	3.00	15.00	41.14
7	82.6A	3.91	.99	2.00	40.00	43.29	3.10	10.00	41.69
8	82.9A	3.56	.96	1.98	40.00	42.27	3.10	11.00	41.58
9	83.2A	3.26	.94	1.96	40.00	41.25	3.10	12.00	41.47

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Harl	LS	Sand	Iron Ore
16.31	2.27	2.56	35.00	20.21	63.93	13.20	2.65
16.09	2.41	2.78	34.97	21.71	63.26	12.12	2.92
15.87	2.55	2.99	34.94	23.20	62.58	11.03	3.19
15.64	2.69	3.21	34.91	24.70	61.91	9.94	3.45
16.73	2.02	2.13	35.06	17.59	65.15	15.16	2.10
16.51	2.16	2.35	35.03	19.08	64.47	14.08	2.37
16.29	2.30	2.56	35.00	20.57	63.80	13.00	2.63
16.06	2.44	2.78	34.97	22.06	63.12	11.91	2.90
15.84	2.57	2.99	34.94	23.56	62.45	10.83	3.17
15.62	2.71	3.21	34.91	25.05	61.77	9.74	3.44
16.71	2.05	2.13	35.07	17.95	65.01	14.96	2.08
16.49	2.19	2.35	35.04	19.44	64.34	13.88	2.35
16.26	2.32	2.56	35.01	20.93	63.66	12.79	2.61
16.04	2.46	2.78	34.97	22.42	62.99	11.71	2.88
15.82	2.60	2.99	34.94	23.92	62.31	10.62	3.15
15.59	2.74	3.21	34.91	25.41	61.64	9.53	3.42
16.68	2.07	2.13	35.07	18.31	64.87	14.76	2.06
16.46	2.21	2.35	35.04	19.80	64.20	13.68	2.33
16.24	2.35	2.56	35.01	21.29	63.53	12.59	2.59
16.01	2.48	2.78	34.98	22.78	62.85	11.51	2.86
15.79	2.62	2.99	34.95	24.28	62.18	10.42	3.13
15.57	2.76	3.21	34.91	25.77	61.50	9.33	3.40
16.66	2.10	2.13	35.07	18.66	64.74	14.56	2.04
16.44	2.23	2.35	35.04	20.16	64.06	13.47	2.31
16.21	2.37	2.56	35.01	21.65	63.39	12.39	2.58
15.99	2.51	2.78	34.98	23.14	62.72	11.30	2.84
15.77	2.65	2.99	34.95	24.63	62.04	10.22	3.11
15.54	2.78	3.21	34.92	26.13	61.36	9.13	3.38
16.63	2.12	2.13	35.07	19.02	64.60	14.35	2.02
16.41	2.26	2.35	35.04	20.51	63.93	13.27	2.29
16.19	2.40	2.56	35.01	22.01	63.25	12.18	2.56

	LSF	SH	AH	NH	CS	CS	CA	CAF	CAO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Harl	LS	Sand	Ironore
140	A3.54	3.01	.91	1.94	4C.00	4C.23	3.10	13.00	41.36	13.96	2.53	2.78	34.98	23.50	62.58	11.10	2.82
1	A3.98	2.78	.89	1.93	4C.00	39.21	3.10	14.00	41.25	15.74	2.67	2.99	34.95	24.99	61.90	10.01	3.09
2	A4.21	2.58	.88	1.91	4C.00	38.19	3.10	15.00	41.13	15.52	2.81	2.21	34.92	26.49	61.23	8.92	3.36
3	A2.47	3.84	1.01	2.00	4C.00	43.19	3.20	10.00	41.69	16.61	2.15	2.13	35.08	19.38	64.47	14.15	2.00
4	A2.98	3.54	.97	1.98	4C.00	42.17	3.20	11.00	41.58	16.39	2.28	2.35	35.05	20.87	63.79	13.07	2.27
5	A3.30	3.24	.94	1.96	4C.00	41.15	3.20	12.00	41.46	16.16	2.42	2.56	35.02	22.36	63.12	11.98	2.54
6	A3.69	2.99	.92	1.94	4C.00	40.13	3.20	13.00	41.35	15.94	2.56	2.78	34.98	23.86	62.44	10.90	2.80
7	A3.54	2.76	.90	1.93	4C.00	39.11	3.20	14.00	41.24	15.72	2.70	2.99	34.95	25.35	61.77	9.81	3.07
8	A4.27	2.56	.88	1.91	4C.00	38.09	3.20	15.00	41.13	15.49	2.83	3.21	34.92	26.85	61.09	8.72	3.34
9	A2.77	3.85	1.02	2.00	4C.00	43.08	3.30	10.00	41.68	16.59	2.17	2.13	35.08	19.74	64.33	13.95	1.98
10	A3.04	3.51	.98	1.98	4C.00	42.06	3.30	11.00	41.57	16.36	2.31	2.35	35.05	21.23	63.66	12.86	2.25
11	A3.35	3.22	.95	1.96	4C.00	41.04	3.30	12.00	41.46	16.14	2.44	2.56	35.02	22.72	62.98	11.78	2.52
12	A3.67	2.97	.93	1.94	4C.00	40.02	3.30	13.00	41.35	15.91	2.58	2.78	34.99	24.22	62.31	10.69	2.79
13	A4.00	2.75	.91	1.93	4C.00	39.00	3.30	14.00	41.23	15.69	2.72	2.99	34.96	25.71	61.95	9.61	3.05
14	A4.39	2.55	.89	1.91	4C.00	37.98	3.30	15.00	41.12	15.47	2.86	3.21	34.92	27.21	60.19	8.52	3.32
15	A2.78	3.83	1.03	2.00	4C.00	42.97	3.40	10.00	41.68	16.56	2.19	2.13	35.08	20.10	64.19	13.74	1.97
16	A3.00	3.49	.99	1.98	4C.00	41.95	3.40	11.00	41.56	16.34	2.33	2.35	35.05	21.59	63.52	12.66	2.23
17	A3.41	3.20	.96	1.96	4C.00	40.93	3.40	12.00	41.45	16.11	2.47	2.56	35.02	23.08	62.85	11.57	2.50
18	A3.73	2.95	.94	1.94	4C.00	39.91	3.40	13.00	41.34	15.89	2.61	2.78	34.99	24.57	62.17	10.49	2.77
19	A4.05	2.73	.92	1.93	4C.00	38.89	3.40	14.00	41.23	15.67	2.74	2.99	34.96	26.07	61.49	9.40	3.03
20	A4.38	2.54	.90	1.91	4C.00	37.87	3.40	15.00	41.11	15.44	2.88	3.21	34.93	27.57	60.82	8.31	3.30
21	A2.83	3.80	1.04	1.99	4C.00	42.87	3.50	10.00	41.67	16.54	2.22	2.13	35.09	20.46	64.06	13.54	1.95
22	A3.15	3.47	1.00	1.98	4C.00	41.85	3.50	11.00	41.56	16.31	2.36	2.35	35.05	21.95	63.38	12.46	2.21
23	A3.46	3.18	.97	1.96	4C.00	40.83	3.50	12.00	41.44	16.09	2.49	2.56	35.02	23.44	62.71	11.37	2.48
24	A3.78	2.93	.95	1.94	4C.00	39.81	3.50	13.00	41.33	15.87	2.63	2.78	34.99	24.93	62.03	10.29	2.75
25	A4.11	2.72	.93	1.93	4C.00	38.79	3.50	14.00	41.22	15.64	2.77	2.99	34.96	26.43	61.36	9.20	3.01
26	A4.44	2.52	.91	1.91	4C.00	37.76	3.50	15.00	41.11	15.42	2.91	3.21	34.93	27.92	60.68	8.11	3.28
27	A1.68	4.94	.64	2.02	42.00	44.61	.00	10.00	41.97	17.28	1.36	2.13	35.05	7.94	68.99	20.46	2.61
28	A1.98	4.43	.64	2.00	42.00	43.58	.00	11.00	41.85	17.06	1.50	2.35	35.02	9.43	68.32	19.38	2.88
29	A2.28	4.01	.64	1.98	42.00	42.56	.00	12.00	41.74	16.83	1.64	2.56	34.99	10.92	67.65	18.29	3.14
30	A2.59	3.65	.64	1.97	42.00	41.54	.00	13.00	41.63	16.61	1.77	2.78	34.96	12.40	66.97	17.21	3.41

LSF	SH	AH	HH	CS	C2S	C3A	C4AF	CAO	S102	Al2O3	Fe2O3	LOI	Harl	LS	Sand	Iron Ore
1 02.90	3.39	.64	1.95	42.00	40.52	.60	14.00	41.52	16.39	1.91	2.99	34.93	13.89	66.30	16.13	3.68
2 03.22	3.07	.64	1.93	42.00	39.50	.60	15.00	41.41	16.16	1.95	3.21	34.90	15.39	65.62	15.04	3.95
3 01.74	4.90	.65	2.02	42.00	44.50	.10	10.00	41.96	17.25	1.39	2.13	35.04	8.30	68.18	20.25	2.59
4 02.04	4.40	.65	2.00	42.00	43.49	.10	11.00	41.85	17.02	1.52	2.35	35.03	9.79	68.18	19.17	2.86
5 02.34	3.98	.65	1.98	42.00	42.46	.10	12.00	41.74	16.81	1.66	2.56	34.99	11.27	67.51	16.09	3.13
6 02.64	3.62	.65	1.97	42.00	41.44	.10	13.00	41.62	16.58	1.80	2.78	34.96	12.76	66.84	17.01	3.39
7 02.94	3.32	.65	1.95	42.00	40.42	.10	14.00	41.51	16.36	1.94	2.99	34.93	14.25	66.16	15.92	3.66
8 03.22	3.06	.65	1.93	42.00	39.40	.10	15.00	41.40	16.14	2.07	3.21	34.90	15.74	65.49	14.84	3.93
9 01.70	4.86	.66	2.02	42.00	44.39	.20	10.00	41.95	17.23	1.41	2.13	35.06	8.66	68.72	20.05	2.57
10 02.00	4.36	.66	2.00	42.00	43.37	.20	11.00	41.84	17.01	1.55	2.35	35.03	10.15	68.05	18.97	2.84
11 02.30	3.95	.66	1.98	42.00	42.35	.20	12.00	41.73	16.78	1.69	2.56	35.00	11.63	67.37	17.89	3.11
12 02.70	3.60	.66	1.97	42.00	41.33	.20	13.00	41.62	16.56	1.82	2.78	34.97	13.12	66.70	16.80	3.37
13 03.01	3.30	.65	1.95	42.00	40.31	.20	14.00	41.51	16.34	1.96	2.99	34.93	14.61	66.03	15.72	3.64
14 03.32	3.04	.65	1.93	42.00	39.29	.20	15.00	41.39	16.11	2.10	3.21	34.90	16.10	65.35	14.64	3.91
15 01.64	4.82	.67	2.02	42.00	44.28	.30	10.00	41.95	17.20	1.44	2.13	35.06	9.02	68.58	19.85	2.55
16 02.14	4.33	.67	2.00	42.00	43.26	.30	11.00	41.83	16.98	1.57	2.35	35.03	10.50	67.91	18.77	2.82
17 02.44	3.92	.67	1.98	42.00	42.24	.30	12.00	41.72	16.76	1.71	2.56	35.00	11.99	67.24	17.68	3.09
18 02.74	3.57	.66	1.97	42.00	41.22	.30	13.00	41.61	16.53	1.85	2.78	34.97	13.48	66.56	16.60	3.35
19 03.07	3.28	.66	1.95	42.00	40.20	.30	14.00	41.50	16.31	1.98	2.99	34.94	14.97	65.89	15.52	3.62
20 03.38	3.02	.66	1.93	42.00	39.18	.30	15.00	41.39	16.09	2.12	3.21	34.91	16.46	65.22	14.43	3.89
21 01.90	4.78	.68	2.02	42.00	44.16	.40	10.00	41.94	17.18	1.46	2.13	35.06	9.38	68.45	19.64	2.53
22 02.20	4.30	.68	2.00	42.00	43.14	.40	11.00	41.83	16.96	1.60	2.35	35.03	10.86	67.77	18.56	2.80
23 02.50	3.89	.68	1.99	42.00	42.14	.40	12.00	41.72	16.73	1.73	2.56	35.00	12.35	67.10	17.48	3.07
24 02.81	3.55	.67	1.97	42.00	41.12	.40	13.00	41.60	16.51	1.87	2.78	34.97	13.84	66.43	16.40	3.34
25 03.12	3.26	.67	1.95	42.00	40.10	.40	14.00	41.49	16.29	2.01	2.99	34.94	15.33	65.75	15.31	3.60
26 03.44	3.00	.67	1.93	42.00	39.08	.40	15.00	41.38	16.06	2.15	3.21	34.91	16.82	65.08	14.23	3.87
27 01.95	4.74	.70	2.02	42.00	44.07	.50	10.00	41.93	17.15	1.48	2.13	35.07	9.74	68.31	19.44	2.51
28 02.25	4.27	.69	2.00	42.00	43.05	.50	11.00	41.82	16.93	1.62	2.35	35.04	11.22	67.64	18.36	2.78
29 02.55	3.87	.69	1.98	42.00	42.03	.50	12.00	41.71	16.71	1.76	2.56	35.00	12.71	66.96	17.28	3.05
30 02.84	3.53	.68	1.97	42.00	41.01	.50	13.00	41.60	16.48	1.90	2.78	34.97	14.20	66.29	16.19	3.32
31 03.14	3.24	.68	1.95	42.00	39.99	.50	14.00	41.49	16.26	2.03	2.99	34.94	15.69	65.62	15.11	3.58
32 03.50	2.98	.68	1.93	42.00	38.97	.50	15.00	41.37	16.04	2.17	3.21	34.91	17.18	64.94	14.02	3.85

	LSF	SH	AH	HH	CAS	C2S	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	Har1	LS	Sand	Iron ore	
3	82.00	4.70	.71	2.02	42.00	43.96	.60	10.00	41.93	17.13	1.51	2.13	35.07	10.09	68.17	19.24	2.50
4	82.30	4.23	.70	2.00	42.00	42.94	.60	11.00	41.82	16.91	1.65	2.35	35.04	11.58	67.50	18.16	2.76
5	82.61	3.84	.70	1.98	42.00	41.92	.60	12.00	41.70	16.68	1.78	2.56	35.01	13.07	66.83	17.07	3.03
6	82.95	3.50	.69	1.97	42.00	40.90	.60	13.00	41.59	16.46	1.92	2.78	34.98	14.56	66.16	15.99	3.30
7	83.23	3.21	.69	1.95	42.00	39.88	.60	14.00	41.48	16.24	2.06	2.99	34.95	16.05	65.48	14.91	3.56
8	83.55	2.96	.68	1.93	42.00	38.86	.60	15.00	41.37	16.01	2.20	3.21	34.91	17.54	64.81	13.82	3.83
9	82.05	4.66	.72	2.00	42.00	43.86	.70	10.00	41.92	17.10	1.67	2.13	35.07	10.45	68.04	19.03	2.48
260	82.36	4.20	.71	2.00	42.00	42.84	.70	11.00	41.81	16.88	1.67	2.35	35.04	11.94	67.37	17.95	2.74
1	82.64	3.81	.71	1.98	42.00	41.82	.70	12.00	41.70	16.66	1.81	2.56	35.01	13.43	66.69	16.87	3.01
2	82.97	3.48	.70	1.97	42.00	40.80	.70	13.00	41.59	16.44	1.94	2.78	34.98	14.92	66.02	15.79	3.28
3	83.29	3.19	.70	1.95	42.00	39.78	.70	14.00	41.47	16.21	2.08	2.99	34.95	16.41	65.34	14.70	3.55
4	83.61	2.95	.69	1.93	42.00	38.76	.70	15.00	41.36	15.99	2.22	3.21	34.92	17.90	64.67	13.62	3.81
5	82.11	4.63	.73	2.02	42.00	43.75	.80	10.00	41.91	17.08	1.56	2.13	35.07	10.81	67.90	18.83	2.46
6	82.41	4.17	.72	2.00	42.00	42.73	.80	11.00	41.80	16.86	1.69	2.35	35.04	12.30	67.23	17.75	2.72
7	82.72	3.78	.71	1.98	42.00	41.71	.80	12.00	41.69	16.63	1.83	2.56	35.01	13.79	66.56	16.67	2.99
8	83.03	3.46	.71	1.97	42.00	40.69	.80	13.00	41.58	16.41	1.97	2.78	34.98	15.28	65.88	15.58	3.26
9	83.34	3.17	.70	1.95	42.00	39.67	.80	14.00	41.47	16.19	2.11	2.99	34.95	16.77	65.21	14.50	3.53
260	83.66	2.93	.70	1.93	42.00	38.65	.80	15.00	41.35	15.96	2.24	3.21	34.92	18.26	64.53	13.41	3.79
1	82.16	4.59	.74	2.02	42.00	43.64	.90	10.00	41.91	17.05	1.58	2.13	35.08	11.17	67.77	18.63	2.44
2	82.46	4.14	.73	2.00	42.00	42.62	.90	11.00	41.80	16.83	1.72	2.35	35.05	12.66	67.09	17.55	2.70
3	82.77	3.76	.72	1.98	42.00	41.60	.90	12.00	41.68	16.61	1.86	2.56	35.01	14.14	66.42	16.46	2.97
4	83.08	3.43	.72	1.96	42.00	40.58	.90	13.00	41.57	16.39	1.99	2.78	34.98	15.63	65.75	15.38	3.24
5	83.40	3.15	.71	1.95	42.00	39.56	.90	14.00	41.46	16.16	2.13	2.99	34.95	17.13	65.07	14.30	3.51
6	83.72	2.91	.71	1.93	42.00	38.54	.90	15.00	41.35	15.94	2.27	3.21	34.92	18.62	64.40	13.21	3.78
7	82.21	4.55	.75	2.02	42.00	43.54	1.00	10.00	41.90	17.03	1.61	2.13	35.08	11.53	67.63	18.42	2.42
8	82.52	4.11	.74	2.00	42.00	42.52	1.00	11.00	41.79	16.81	1.74	2.35	35.05	13.01	66.96	17.34	2.69
9	82.84	3.73	.73	1.98	42.00	41.50	1.00	12.00	41.68	16.58	1.88	2.56	35.02	14.50	66.28	16.26	2.95
260	83.16	3.41	.73	1.96	42.00	40.48	1.00	13.00	41.57	16.36	2.02	2.78	34.99	15.99	65.61	15.18	3.22
1	83.46	3.13	.72	1.95	42.00	39.45	1.00	14.00	41.45	16.14	2.16	2.99	34.96	17.48	64.94	14.09	3.49
2	83.78	2.89	.71	1.93	42.00	38.43	1.00	15.00	41.34	15.91	2.29	3.21	34.92	18.98	64.26	13.01	3.76
3	82.27	4.52	.76	2.02	42.00	43.43	1.10	10.00	41.90	17.01	1.63	2.13	35.08	11.29	67.49	18.22	2.40

	LSF	SM	AH	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	C ₂ O	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Harl	LS	Sand	Iron Ore
4	182.57	4.08	.75	2.00	42.00	42.41	1.10	11.00	41.78	16.78	1.77	2.35	35.05	13.37	66.82	17.14	2.67
5	182.88	3.71	.74	1.98	42.00	41.39	1.10	12.00	41.67	16.56	1.91	2.56	35.02	14.86	66.15	16.06	2.93
6	183.10	3.39	.74	1.96	42.00	40.37	1.10	13.00	41.56	16.34	2.04	2.78	34.99	16.35	65.97	14.97	3.20
7	183.51	3.12	.73	1.95	42.00	39.35	1.10	14.00	41.45	16.11	2.18	2.99	34.96	17.84	64.80	13.89	3.47
8	183.83	2.88	.72	1.93	42.00	38.33	1.10	15.00	41.34	15.89	2.32	3.21	34.93	19.34	64.12	12.80	3.74
9	182.37	4.48	.78	2.02	42.00	43.22	1.20	10.00	41.89	16.98	1.66	2.13	35.08	12.24	67.36	18.02	2.38
10	182.63	4.05	.76	2.00	42.00	42.30	1.20	11.00	41.78	16.76	1.79	2.35	35.05	13.73	66.68	16.94	2.65
11	182.94	3.68	.75	1.98	42.00	41.28	1.20	12.00	41.67	16.53	1.93	2.56	35.02	15.22	66.01	15.85	2.91
12	183.25	3.37	.74	1.96	42.00	40.26	1.20	13.00	41.55	16.31	2.07	2.78	34.99	16.71	65.34	14.77	3.18
13	183.57	3.10	.74	1.95	42.00	39.24	1.20	14.00	41.44	16.09	2.20	2.99	34.96	18.20	64.66	13.68	3.45
14	183.89	2.86	.73	1.93	42.00	38.22	1.20	15.00	41.33	15.86	2.34	3.21	34.93	19.69	63.99	12.60	3.72
15	182.37	4.45	.79	2.02	42.00	43.22	1.30	10.00	41.88	16.96	1.68	2.13	35.09	12.60	67.22	17.81	2.36
16	182.68	4.02	.77	2.00	42.00	42.20	1.30	11.00	41.77	16.73	1.82	2.35	35.06	14.09	66.55	16.73	2.63
17	182.99	3.66	.76	1.98	42.00	41.17	1.30	12.00	41.66	16.51	1.95	2.56	35.03	15.58	65.88	15.65	2.90
18	183.30	3.35	.75	1.96	42.00	40.15	1.30	13.00	41.55	16.29	2.09	2.78	34.99	17.07	65.20	14.57	3.16
19	183.62	3.08	.75	1.95	42.00	39.13	1.30	14.00	41.43	16.06	2.23	2.99	34.96	18.56	64.53	13.48	3.43
20	183.95	2.84	.74	1.93	42.00	38.11	1.30	15.00	41.32	15.84	2.37	3.21	34.93	20.05	63.85	12.40	3.70
21	182.43	4.41	.80	2.02	42.00	43.11	1.40	10.00	41.88	16.93	1.70	2.13	35.09	12.96	67.09	17.61	2.34
22	182.73	3.99	.78	2.00	42.00	42.09	1.40	11.00	41.76	16.71	1.84	2.35	35.06	14.45	66.41	16.53	2.61
23	183.04	3.63	.77	1.98	42.00	41.07	1.40	12.00	41.65	16.48	1.98	2.56	35.03	15.94	65.74	15.45	2.88
24	183.34	3.32	.76	1.96	42.00	40.05	1.40	13.00	41.54	16.26	2.12	2.78	35.00	17.43	65.07	14.36	3.14
25	183.64	3.06	.75	1.95	42.00	39.03	1.40	14.00	41.43	16.04	2.25	2.99	34.97	18.92	64.39	13.28	3.41
26	182.00	2.82	.75	1.93	42.00	38.01	1.40	15.00	41.32	15.81	2.39	3.21	34.93	20.41	63.72	12.19	3.68
27	182.48	4.38	.81	2.02	42.00	43.00	1.50	10.00	41.87	16.91	1.73	2.13	35.09	13.32	66.95	17.41	2.32
28	182.70	3.96	.79	2.00	42.00	41.98	1.50	11.00	41.76	16.68	1.87	2.35	35.06	14.81	66.28	16.33	2.59
29	183.10	3.61	.78	1.98	42.00	40.96	1.50	12.00	41.65	16.46	2.00	2.56	35.03	16.30	65.60	15.24	2.86
30	183.42	3.30	.77	1.96	42.00	39.94	1.50	13.00	41.53	16.24	2.14	2.78	35.00	17.79	64.93	14.16	3.12
31	183.74	3.04	.76	1.95	42.00	38.92	1.50	14.00	41.42	16.01	2.28	2.99	34.97	19.28	64.25	13.07	3.39
32	184.06	2.81	.75	1.93	42.00	37.90	1.50	15.00	41.31	15.79	2.42	3.21	34.94	20.77	63.58	11.99	3.66
33	182.53	4.34	.82	2.02	42.00	42.89	1.60	10.00	41.86	16.88	1.75	2.13	35.09	13.68	66.81	17.20	2.30
34	182.84	3.93	.81	2.00	42.00	41.87	1.60	11.00	41.75	16.66	1.89	2.35	35.06	15.17	66.14	16.12	2.57

LSF	SH	AH	HH	C3S	C2S	C3A	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	Hard	LS	Sand	Iron Ore
5 83.15	3.58	.77	1.98	42.00	40.85	1.60	12.00	41.64	16.43	2.03	2.56	35.03	16.65	45.47	15.04	2.84
6 83.47	3.28	.78	1.96	42.00	39.83	1.60	13.00	41.53	16.21	2.16	2.78	35.00	18.14	44.79	13.96	3.11
7 83.79	3.02	.77	1.95	42.00	38.81	1.60	14.00	41.42	15.99	2.30	2.99	34.97	19.64	44.12	12.87	3.37
8 84.19	2.79	.76	1.93	42.00	37.79	1.60	15.00	41.30	15.76	2.44	3.21	34.94	21.13	43.44	11.79	3.64
9 82.58	4.31	.83	2.02	42.00	42.79	1.70	10.00	41.86	16.86	1.78	2.13	35.10	14.04	46.68	17.00	2.29
320 82.98	3.90	.82	2.00	42.00	41.77	1.70	11.00	41.75	16.63	1.91	2.35	35.07	15.52	46.00	15.92	2.55
1 83.21	3.56	.80	1.98	42.00	40.75	1.70	12.00	41.63	16.41	2.05	2.56	35.04	17.01	45.33	14.84	2.82
2 83.57	3.26	.79	1.96	42.00	39.73	1.70	13.00	41.52	16.19	2.19	2.78	35.00	18.50	44.66	13.75	3.09
3 83.82	3.00	.78	1.95	42.00	38.71	1.70	14.00	41.41	15.97	2.33	2.99	34.97	20.00	43.98	12.67	3.35
4 84.17	2.78	.77	1.93	42.00	37.69	1.70	15.00	41.30	15.74	2.46	3.21	34.94	21.49	43.31	11.58	3.62
5 82.64	4.28	.85	2.02	42.00	42.68	1.80	10.00	41.85	16.83	1.80	2.13	35.10	14.39	46.54	16.80	2.27
6 82.92	3.87	.83	2.00	42.00	41.66	1.80	11.00	41.74	16.61	1.94	2.35	35.07	15.88	45.87	15.72	2.53
7 83.24	3.53	.81	1.98	42.00	40.64	1.80	12.00	41.63	16.38	2.08	2.56	35.04	17.37	45.19	14.63	2.80
8 83.58	3.24	.80	1.96	42.00	39.62	1.80	13.00	41.51	16.16	2.21	2.78	35.01	18.86	44.52	13.55	3.07
9 83.90	2.98	.79	1.95	42.00	38.60	1.80	14.00	41.40	15.94	2.35	2.99	34.98	20.35	43.85	12.46	3.34
330 84.29	2.76	.78	1.93	42.00	37.58	1.80	15.00	41.29	15.71	2.49	3.21	34.94	21.85	43.17	11.38	3.60
1 82.78	4.24	.86	2.02	42.00	42.57	1.90	10.00	41.84	16.81	1.83	2.13	35.10	14.75	46.40	16.60	2.25
2 83.01	3.85	.84	2.00	42.00	41.55	1.90	11.00	41.73	16.58	1.96	2.35	35.07	16.24	45.73	15.51	2.51
3 83.35	3.51	.82	1.98	42.00	40.53	1.90	12.00	41.62	16.36	2.10	2.56	35.04	17.73	45.06	14.43	2.78
4 83.69	3.22	.81	1.96	42.00	39.51	1.90	13.00	41.51	16.14	2.24	2.78	35.01	19.22	44.38	13.35	3.05
5 83.96	2.96	.79	1.95	42.00	38.49	1.90	14.00	41.40	15.91	2.38	2.99	34.98	20.71	43.71	12.26	3.32
6 84.29	2.74	.78	1.93	42.00	37.47	1.90	15.00	41.28	15.69	2.51	3.21	34.95	22.21	43.03	11.18	3.58
7 82.72	4.21	.87	2.01	42.00	42.47	2.00	10.00	41.84	16.78	1.85	2.13	35.10	15.11	46.127	16.39	2.23
8 83.04	3.82	.85	2.00	42.00	41.45	2.00	11.00	41.73	16.56	1.99	2.35	35.07	16.60	45.460	15.31	2.49
9 83.38	3.49	.83	1.98	42.00	40.43	2.00	12.00	41.61	16.34	2.13	2.56	35.04	18.09	44.792	14.23	2.76
340 83.68	3.20	.82	1.96	42.00	39.41	2.00	13.00	41.50	16.11	2.26	2.78	35.01	19.58	44.125	13.14	3.03
1 84.02	2.95	.80	1.95	42.00	38.39	2.00	14.00	41.39	15.89	2.40	2.99	34.98	21.07	43.57	12.06	3.30
2 84.35	2.73	.79	1.93	42.00	37.37	2.00	15.00	41.28	15.66	2.54	3.21	34.95	22.56	42.90	10.97	3.56
3 84.61	4.16	.88	2.01	42.00	42.36	2.10	10.00	41.83	16.76	1.88	2.13	35.11	15.47	46.13	15.11	2.28
4 83.15	3.79	.86	2.00	42.00	41.34	2.10	11.00	41.72	16.53	2.01	2.35	35.08	16.96	45.46	14.02	2.48
5 83.47	3.46	.84	1.98	42.00	40.32	2.10	12.00	41.61	16.31	2.15	2.56	35.05	18.45	44.79	12.94	2.74
6 83.72	3.18	.82	1.96	42.00	39.30	2.10	13.00	41.50	16.09	2.29	2.78	35.01	19.94	44.11	12.94	3.01

LSF	SH	AH	HM	C3S	C2S	C3A	C4AF	CaO	SiO2	H2O3	Fe2O3	LOI	Marl	LS	Sand	Iron Ore
1 24.07	2.93	.81	1.94	42.00	38.28	2.10	14.00	41.38	15.86	2.42	2.99	34.78	21.43	63.44	11.85	3.28
2 24.40	2.71	.80	1.93	42.00	37.26	2.10	15.00	41.27	15.64	2.56	3.21	32.95	22.92	62.76	10.77	3.55
3 22.84	4.15	.89	2.01	42.00	42.25	2.20	10.00	41.82	16.73	1.90	2.13	35.11	15.83	66.00	15.99	2.19
3 23.17	3.77	.87	2.00	42.00	41.23	2.20	11.00	41.71	16.51	2.04	2.35	35.08	17.32	65.32	14.90	2.46
4 23.49	3.44	.85	1.98	42.00	40.21	2.20	12.00	41.60	16.29	2.17	2.56	35.05	18.80	64.65	13.82	2.72
5 23.81	3.16	.83	1.96	42.00	39.19	2.20	13.00	41.49	16.06	2.31	2.78	35.02	20.30	63.98	12.74	2.99
6 24.13	2.91	.82	1.94	42.00	38.17	2.20	14.00	41.38	15.84	2.45	2.99	34.99	21.79	63.30	11.65	3.26
7 24.44	2.70	.81	1.93	42.00	37.15	2.20	15.00	41.27	15.61	2.59	3.21	34.95	23.28	62.63	10.57	3.53
8 24.76	4.12	.90	2.01	42.00	42.15	2.30	10.00	41.82	16.71	1.92	2.13	35.11	16.19	65.86	15.78	2.17
9 25.08	3.74	.88	2.00	42.00	41.13	2.30	11.00	41.71	16.48	2.06	2.35	35.08	17.67	65.19	14.70	2.44
10 25.40	3.42	.86	1.98	42.00	40.11	2.30	12.00	41.59	16.26	2.20	2.56	35.05	19.16	64.51	13.62	2.70
11 25.72	3.14	.84	1.96	42.00	39.09	2.30	13.00	41.48	16.04	2.34	2.78	35.02	20.65	63.84	12.53	2.97
12 26.04	2.89	.83	1.94	42.00	38.07	2.30	14.00	41.37	15.81	2.47	2.99	34.99	22.15	63.17	11.45	3.24
13 26.36	2.68	.81	1.93	42.00	37.04	2.30	15.00	41.26	15.59	2.61	3.21	34.96	23.64	62.49	10.36	3.51
14 26.68	4.09	.89	2.01	42.00	42.02	2.40	11.00	41.81	16.68	1.95	2.13	35.12	16.54	65.73	15.58	2.15
15 27.00	3.71	.87	2.00	42.00	41.00	2.40	12.00	41.70	16.46	2.09	2.35	35.08	18.03	65.05	14.50	2.42
16 27.32	3.39	.85	1.98	42.00	40.00	2.40	13.00	41.59	16.24	2.22	2.56	35.05	19.52	64.38	13.41	2.69
17 27.64	3.12	.83	1.96	42.00	38.98	2.40	14.00	41.48	16.01	2.36	2.78	35.02	21.01	63.70	12.33	2.95
18 27.96	2.88	.81	1.94	42.00	37.96	2.40	15.00	41.36	15.79	2.50	2.99	34.99	22.51	63.03	11.24	3.22
19 28.28	2.66	.80	1.93	42.00	36.94	2.40	16.00	41.25	15.56	2.64	3.21	34.96	24.00	62.35	10.16	3.49
20 28.60	4.06	.93	2.01	42.00	41.93	2.50	10.00	41.81	16.66	1.97	2.13	35.12	16.90	65.59	15.38	2.13
21 28.92	3.69	.90	2.00	42.00	40.91	2.50	11.00	41.69	16.43	2.11	2.35	35.09	18.39	64.92	14.29	2.40
22 29.24	3.37	.88	1.98	42.00	39.89	2.50	12.00	41.58	16.21	2.25	2.56	35.06	19.88	64.24	13.21	2.67
23 29.56	3.10	.86	1.96	42.00	38.87	2.50	13.00	41.47	15.99	2.38	2.78	35.02	21.37	63.57	12.13	2.93
24 29.88	2.86	.84	1.94	42.00	37.85	2.50	14.00	41.36	15.76	2.52	2.99	34.99	22.86	62.89	11.04	3.20
25 30.20	2.65	.83	1.93	42.00	36.83	2.50	15.00	41.25	15.54	2.66	3.21	34.96	24.36	62.22	9.96	3.47
26 30.52	4.03	.94	2.01	42.00	41.81	2.60	10.00	41.80	16.63	2.00	2.13	35.12	17.26	65.45	15.17	2.11
27 30.84	3.66	.91	2.00	42.00	40.81	2.60	11.00	41.69	16.41	2.13	2.35	35.09	18.75	64.78	14.09	2.38
28 31.16	3.35	.89	1.98	42.00	39.78	2.60	12.00	41.58	16.19	2.27	2.56	35.06	20.24	64.11	13.01	2.65
29 31.48	3.08	.87	1.96	42.00	38.76	2.60	13.00	41.46	15.96	2.41	2.78	35.03	21.73	63.43	11.92	2.91
30 31.80	2.84	.85	1.94	42.00	37.74	2.60	14.00	41.35	15.74	2.55	2.99	35.00	23.22	62.76	10.84	3.18
31 32.12	2.63	.84	1.93	42.00	36.72	2.60	15.00	41.24	15.52	2.68	3.21	34.96	24.72	62.08	9.75	3.45

	LSF	SH	AH	HH	CS	CS	CSA	CANF	CaO	SiO2	Al2O3	Fe2O3	LOI	Hard	LS	Sand	Iron Ore
4	83.17	4.00	.95	2.01	42.00	41.72	2.70	10.00	41.77	16.61	2.02	2.13	35.12	17.62	65.32	14.97	2.09
380	83.44	3.64	.92	2.00	42.00	40.70	2.70	11.00	41.68	16.38	2.16	2.35	35.09	19.11	64.64	13.89	2.36
1	83.77	3.33	.90	1.90	42.00	39.68	2.70	12.00	41.57	16.16	2.30	2.56	35.06	20.60	63.97	12.80	2.63
2	84.09	3.06	.88	1.96	42.00	38.66	2.70	13.00	41.46	15.94	2.43	2.78	35.03	22.09	63.30	11.72	2.90
3	84.42	2.83	.86	1.94	42.00	37.64	2.70	14.00	41.35	15.71	2.57	2.99	35.00	23.58	62.62	10.64	3.16
4	84.75	2.62	.85	1.93	42.00	36.62	2.70	15.00	41.23	15.49	2.71	3.21	34.97	25.08	61.95	9.55	3.43
5	83.19	3.97	.96	2.01	42.00	41.61	2.80	10.00	41.79	16.58	2.05	2.13	35.13	17.97	65.51	14.77	2.08
6	83.50	3.61	.93	2.00	42.00	40.59	2.80	11.00	41.67	16.36	2.18	2.35	35.09	19.46	64.51	13.69	2.34
7	83.81	3.31	.91	1.98	42.00	39.57	2.80	12.00	41.56	16.14	2.32	2.56	35.06	20.95	63.83	12.60	2.61
8	84.14	3.04	.89	1.96	42.00	38.55	2.80	13.00	41.45	15.91	2.46	2.78	35.03	22.45	63.16	11.52	2.88
9	84.47	2.81	.87	1.94	42.00	37.53	2.80	14.00	41.34	15.69	2.60	2.99	35.00	23.94	62.49	10.43	3.14
34	84.81	2.60	.85	1.93	42.00	36.51	2.80	15.00	41.23	15.47	2.73	3.21	34.97	25.43	61.81	9.35	3.41
1	83.24	3.94	.97	2.01	42.00	41.50	2.90	10.00	41.78	16.56	2.07	2.13	35.13	18.33	65.05	14.56	2.06
2	83.56	3.59	.94	1.99	42.00	40.48	2.90	11.00	41.67	16.33	2.21	2.35	35.10	19.82	64.37	13.48	2.32
3	83.88	3.28	.92	1.98	42.00	39.46	2.90	12.00	41.56	16.11	2.35	2.56	35.07	21.31	63.70	12.40	2.59
4	84.20	3.02	.89	1.96	42.00	38.44	2.90	13.00	41.44	15.89	2.48	2.78	35.03	22.80	63.02	11.31	2.86
5	84.52	2.79	.88	1.94	42.00	37.42	2.90	14.00	41.33	15.66	2.62	2.99	35.00	24.30	62.35	10.23	3.12
6	84.87	2.59	.86	1.93	42.00	36.40	2.90	15.00	41.22	15.44	2.76	3.21	34.97	25.79	61.67	9.14	3.39
7	83.30	3.91	.98	2.01	42.00	41.40	3.00	11.00	41.77	16.53	2.10	2.13	35.13	18.69	64.94	14.36	2.04
8	83.61	3.56	.95	1.99	42.00	40.38	3.00	12.00	41.66	16.31	2.23	2.35	35.10	20.18	64.24	13.28	2.30
9	83.93	3.26	.93	1.98	42.00	39.36	3.00	13.00	41.55	16.09	2.37	2.56	35.07	21.67	63.56	12.20	2.57
40	84.26	3.00	.90	1.96	42.00	38.34	3.00	14.00	41.44	15.86	2.51	2.78	35.04	23.16	62.89	11.11	2.84
1	84.58	2.78	.88	1.94	42.00	37.32	3.00	15.00	41.33	15.64	2.64	2.99	35.01	24.66	62.21	10.03	3.11
2	84.92	2.57	.87	1.93	42.00	36.30	3.00	16.00	41.21	15.42	2.78	3.21	34.98	26.15	61.54	8.94	3.37
3	83.32	3.98	.99	2.01	42.00	41.29	3.10	10.00	41.77	16.51	2.12	2.13	35.13	19.05	64.77	14.16	2.02
4	83.67	3.54	.96	1.99	42.00	40.27	3.10	11.00	41.66	16.29	2.26	2.35	35.10	20.54	64.10	13.08	2.29
5	83.99	3.24	.94	1.98	42.00	39.25	3.10	12.00	41.55	16.06	2.39	2.56	35.07	22.03	63.43	11.99	2.55
6	84.32	2.98	.91	1.96	42.00	38.23	3.10	13.00	41.43	15.84	2.53	2.77	35.04	23.52	62.75	10.91	2.82
7	84.64	2.76	.89	1.94	42.00	37.21	3.10	14.00	41.32	15.61	2.67	2.99	35.01	25.01	62.08	9.82	3.09
8	84.99	2.56	.88	1.93	42.00	36.19	3.10	15.00	41.21	15.39	2.81	3.20	34.98	26.51	61.41	8.74	3.35
9	83.41	3.86	1.01	2.01	42.00	41.18	3.20	10.00	41.76	16.48	2.14	2.13	35.14	19.41	64.64	13.96	2.00

LSF	SH	AH	HH	C3S	C2S	C3A	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	Har1	Loss	Sun5	Ironore
410 83.72	3.51	.97	1.99	42.00	40.16	3.20	11.00	41.65	16.26	2.28	2.35	35.10	20.90	63.96	12.87	2.27
1 84.02	3.22	.94	1.98	42.00	39.14	3.20	12.00	41.54	16.04	2.42	2.56	35.07	22.39	63.29	11.79	2.53
2 84.37	2.97	.92	1.96	42.00	38.12	3.20	13.00	41.43	15.81	2.56	2.77	35.04	23.88	62.62	10.70	2.80
3 84.70	2.74	.90	1.94	42.00	37.10	3.20	14.00	41.31	15.59	2.69	2.99	35.01	25.37	61.94	9.62	3.07
4 85.04	2.55	.88	1.93	42.00	36.08	3.20	15.00	41.20	15.37	2.83	3.20	34.98	26.87	61.27	8.53	3.33
5 83.44	3.83	1.02	1.93	42.00	41.08	3.30	10.00	41.75	16.46	2.17	2.13	35.14	19.76	64.50	13.75	3.198
6 83.72	3.49	.98	1.99	42.00	40.06	3.30	11.00	41.64	16.24	2.31	2.35	35.11	21.25	63.83	12.67	2.825
7 84.10	3.20	.95	1.98	42.00	39.04	3.30	12.00	41.53	16.01	2.44	2.56	35.08	22.74	63.15	11.59	2.51
8 84.41	2.95	.93	1.96	42.00	38.02	3.30	13.00	41.42	15.79	2.58	2.77	35.04	24.24	62.48	10.50	2.78
9 84.74	2.73	.91	1.94	42.00	37.00	3.30	14.00	41.31	15.57	2.72	2.99	35.01	25.73	61.81	9.42	3.05
420 85.10	2.53	.89	1.92	42.00	35.98	3.30	15.00	41.19	15.34	2.86	3.20	34.98	27.23	61.13	8.33	3.32
1 83.55	3.80	1.03	2.01	42.00	40.97	3.40	10.00	41.75	16.43	2.19	2.13	35.14	20.12	64.37	13.55	3.132
2 83.84	3.47	.99	1.99	42.00	39.95	3.40	11.00	41.64	16.21	2.33	2.35	35.11	21.61	63.69	12.47	2.823
3 84.14	3.18	.96	1.98	42.00	38.93	3.40	12.00	41.52	15.99	2.47	2.56	35.08	23.10	63.02	11.38	2.549
4 84.49	2.93	.94	1.96	42.00	37.91	3.40	13.00	41.41	15.76	2.60	2.77	35.05	24.59	62.34	10.30	2.776
5 84.80	2.71	.92	1.94	42.00	36.89	3.40	14.00	41.30	15.54	2.74	2.99	35.02	26.09	61.67	9.21	3.003
6 85.14	2.52	.90	1.92	42.00	35.87	3.40	15.00	41.19	15.32	2.88	3.20	34.99	27.58	60.99	8.13	3.30
7 83.57	3.94	1.04	2.01	42.00	40.86	3.50	10.00	41.74	16.41	2.22	2.13	35.14	20.48	64.23	13.35	3.194
8 83.80	3.77	.97	1.99	42.00	39.84	3.50	11.00	41.63	16.19	2.35	2.35	35.11	21.97	63.56	12.26	2.821
9 84.22	3.16	.95	1.98	42.00	38.82	3.50	12.00	41.52	15.96	2.49	2.56	35.08	23.46	62.88	11.18	2.748
430 84.54	2.91	.93	1.96	42.00	37.80	3.50	13.00	41.41	15.74	2.63	2.77	35.05	24.95	62.21	10.10	2.774
1 84.80	2.70	.93	1.94	42.00	36.78	3.50	14.00	41.29	15.52	2.77	2.99	35.02	26.45	61.53	9.01	3.001
2 85.20	2.50	.91	1.92	42.00	35.76	3.50	15.00	41.18	15.29	2.90	3.20	34.99	27.94	60.86	7.92	3.328
3 82.40	4.91	.64	2.04	44.00	42.60	.00	10.00	42.04	17.15	1.36	2.13	35.11	7.98	69.16	20.26	2.61
4 82.71	4.40	.64	2.02	44.00	41.58	.00	11.00	41.93	16.93	1.50	2.35	35.08	9.46	68.49	19.18	2.87
5 83.00	3.98	.64	2.00	44.00	40.56	.00	12.00	41.82	16.71	1.64	2.56	35.05	10.95	67.81	18.10	3.14
6 83.31	3.62	.64	1.98	44.00	39.54	.00	13.00	41.70	16.48	1.77	2.78	35.02	12.44	67.14	17.02	3.41
7 83.65	3.32	.64	1.97	44.00	38.52	.00	14.00	41.59	16.26	1.91	2.99	34.99	13.92	66.47	15.93	3.67
8 83.90	3.05	.64	1.95	44.00	37.50	.00	15.00	41.48	16.04	2.05	3.21	34.96	15.41	65.80	14.85	3.94
9 82.40	4.87	.65	2.04	44.00	42.50	.10	10.00	42.03	17.13	1.39	2.13	35.11	8.34	69.02	20.06	2.59

	L5F	SH	AH	HH	C5S	C2S	C5A	C4AF	CAO	SiO2	Al2O3	Fe2O3	LOI	Hard	LS	Sand	Iron Ore
440	82.76	4.37	.65	2.02	44.00	41.47	.10	11.00	41.92	16.90	1.52	2.35	35.08	9.82	68.35	18.98	2.85
1	83.07	3.95	.65	2.00	44.00	40.45	.10	12.00	41.81	16.68	1.66	2.56	35.05	11.21	67.60	17.89	3.12
2	83.28	3.40	.65	1.98	44.00	39.43	.10	13.00	41.70	16.46	1.80	2.78	35.02	12.79	67.01	16.81	3.39
3	83.70	3.30	.65	1.97	44.00	38.41	.10	14.00	41.58	16.23	1.93	2.99	34.99	14.28	66.33	15.73	3.66
4	84.07	3.03	.65	1.95	44.00	37.39	.10	15.00	41.47	16.01	2.07	3.21	34.96	15.77	65.66	14.64	3.92
5	82.51	4.83	.66	2.02	44.00	42.39	.20	10.00	42.03	17.10	1.41	2.13	35.12	8.69	68.89	19.85	2.57
6	82.81	4.34	.66	2.00	44.00	41.37	.20	11.00	41.91	16.88	1.55	2.35	35.09	10.18	68.21	18.77	2.83
7	83.17	3.92	.66	2.00	44.00	40.35	.20	12.00	41.80	16.66	1.68	2.56	35.06	11.67	67.54	17.69	3.10
8	83.44	3.57	.66	1.98	44.00	39.33	.20	13.00	41.69	16.43	1.82	2.78	35.02	13.15	66.87	16.61	3.37
9	83.74	3.28	.65	1.97	44.00	38.31	.20	14.00	41.58	16.21	1.96	2.99	34.99	14.64	66.20	15.53	3.64
450	84.00	3.02	.65	1.95	44.00	37.29	.20	15.00	41.47	15.99	2.10	3.21	34.96	16.13	65.52	14.44	3.90
1	82.56	4.79	.67	2.04	44.00	42.28	.30	10.00	42.02	17.08	1.43	2.13	35.12	9.05	68.75	19.65	2.55
2	82.87	4.30	.67	2.02	44.00	41.26	.30	11.00	41.91	16.85	1.57	2.35	35.09	10.54	68.08	18.57	2.81
3	83.10	3.90	.66	2.00	44.00	40.24	.30	12.00	41.80	16.63	1.71	2.56	35.06	12.02	67.41	17.49	3.08
4	83.40	3.55	.66	1.98	44.00	39.22	.30	13.00	41.68	16.41	1.85	2.78	35.03	13.51	66.73	16.41	3.35
5	83.81	3.25	.66	1.96	44.00	38.20	.30	14.00	41.57	16.18	1.98	2.99	35.00	15.00	66.06	15.32	3.62
6	84.14	3.00	.66	1.95	44.00	37.18	.30	15.00	41.46	15.96	2.12	3.21	34.96	16.49	65.39	14.24	3.88
7	82.62	4.75	.68	2.04	44.00	42.17	.40	10.00	42.01	17.05	1.46	2.13	35.12	9.41	68.61	19.45	2.53
8	82.99	4.27	.68	2.02	44.00	41.15	.40	11.00	41.90	16.83	1.60	2.35	35.09	10.90	67.94	18.37	2.80
9	83.29	3.87	.68	2.00	44.00	40.13	.40	12.00	41.79	16.61	1.73	2.56	35.06	12.38	67.27	17.28	3.06
450	83.55	3.53	.67	1.98	44.00	39.11	.40	13.00	41.68	16.38	1.87	2.78	35.03	13.87	66.60	16.20	3.33
1	83.87	3.23	.67	1.96	44.00	38.09	.40	14.00	41.57	16.16	2.01	2.99	35.00	15.36	65.92	15.12	3.60
2	84.20	2.98	.67	1.95	44.00	37.07	.40	15.00	41.45	15.94	2.14	3.21	34.97	16.85	65.25	14.03	3.87
3	82.67	4.71	.70	2.03	44.00	42.07	.50	10.00	42.01	17.03	1.48	2.13	35.12	9.77	68.48	19.24	2.51
4	82.98	4.24	.69	2.02	44.00	41.05	.50	11.00	41.89	16.80	1.62	2.35	35.09	11.25	67.81	18.16	2.78
5	83.20	3.84	.69	2.00	44.00	40.03	.50	12.00	41.78	16.58	1.76	2.56	35.06	12.74	67.13	17.08	3.04
6	83.61	3.50	.68	1.98	44.00	39.01	.50	13.00	41.67	16.36	1.89	2.78	35.03	14.23	66.46	16.00	3.31
7	83.99	3.21	.68	1.95	44.00	37.99	.50	14.00	41.56	16.13	2.03	2.99	35.00	15.72	65.79	14.92	3.58
8	84.20	2.96	.68	1.95	44.00	36.97	.50	15.00	41.45	15.91	2.17	3.21	34.97	17.21	65.11	13.83	3.85
9	82.70	4.67	.71	2.03	44.00	41.96	.60	10.00	42.00	17.00	1.51	2.13	35.13	10.13	68.34	19.04	2.49
450	83.00	4.20	.70	2.02	44.00	40.94	.60	11.00	41.89	16.78	1.64	2.35	35.10	11.61	67.67	17.96	2.76
1	83.30	3.81	.70	2.00	44.00	39.92	.60	12.00	41.78	16.56	1.78	2.56	35.07	13.10	67.00	16.88	3.02

	LSF	SH	AH	HH	GS	CS	GA	CAF	CAO	SiO2	Al2O3	FeO3	LOI	Har/	LS	Sand	Iron Ore
7	83.66	3.98	.69	1.98	44.00	38.90	.60	13.00	41.66	16.32	1.92	2.78	35.03	14.59	66.33	15.80	3.29
8	83.94	3.19	.69	1.96	44.00	37.88	.60	14.00	41.55	16.11	2.06	2.99	35.00	16.08	65.65	14.71	3.56
9	84.31	2.94	.68	1.95	44.00	36.86	.60	15.00	41.44	15.89	2.19	3.21	34.97	17.57	64.98	13.63	3.83
10	82.72	4.63	.72	2.03	44.00	41.85	.70	10.00	41.99	16.98	1.53	2.13	35.13	10.49	68.21	18.84	2.47
11	83.00	4.17	.71	2.02	44.00	40.83	.70	11.00	41.88	16.75	1.67	2.35	35.10	11.97	67.53	17.76	2.74
12	83.44	3.79	.71	2.00	44.00	39.81	.70	12.00	41.77	16.53	1.81	2.56	35.07	13.46	66.86	16.67	3.01
13	83.77	3.46	.70	1.98	44.00	38.79	.70	13.00	41.66	16.31	1.94	2.78	35.04	14.95	66.19	15.59	3.27
14	84.04	3.17	.70	1.96	44.00	37.77	.70	14.00	41.55	16.09	2.08	2.99	35.01	16.44	65.52	14.51	3.54
15	84.37	2.92	.69	1.95	44.00	36.75	.70	15.00	41.43	15.86	2.22	3.21	34.97	17.93	64.84	13.42	3.81
16	82.83	4.60	.73	2.03	44.00	40.73	.80	10.00	41.99	16.95	1.56	2.13	35.13	10.84	68.07	18.63	2.45
17	83.14	4.14	.72	2.02	44.00	39.71	.80	11.00	41.88	16.73	1.69	2.35	35.10	12.33	67.40	17.55	2.72
18	83.45	3.76	.71	2.00	44.00	38.69	.80	12.00	41.76	16.51	1.83	2.56	35.07	13.82	66.73	16.47	2.99
19	83.77	3.43	.71	1.98	44.00	37.67	.80	13.00	41.65	16.28	1.97	2.78	35.04	15.30	66.05	15.39	3.25
20	84.10	3.15	.70	1.96	44.00	36.65	.80	14.00	41.54	16.06	2.10	2.99	35.01	16.79	65.38	14.31	3.52
21	84.42	2.91	.70	1.95	44.00	35.63	.80	15.00	41.43	15.84	2.24	3.20	34.98	18.29	64.71	13.22	3.79
22	82.84	4.56	.74	2.03	44.00	41.64	.90	10.00	41.98	16.93	1.58	2.13	35.13	11.20	67.93	18.43	2.43
23	83.24	4.11	.73	2.02	44.00	40.62	.90	11.00	41.87	16.71	1.72	2.35	35.10	12.69	67.26	17.35	2.70
24	83.51	3.73	.72	2.00	44.00	39.60	.90	12.00	41.76	16.48	1.85	2.56	35.07	14.17	66.59	16.27	2.97
25	83.87	3.41	.72	1.98	44.00	38.58	.90	13.00	41.65	16.26	1.99	2.77	35.04	15.66	65.92	15.19	3.23
26	84.15	3.13	.71	1.96	44.00	37.56	.90	14.00	41.53	16.04	2.13	2.99	35.01	17.15	65.24	14.10	3.50
27	84.48	2.89	.71	1.95	44.00	36.54	.90	15.00	41.42	15.81	2.27	3.20	34.98	18.64	64.57	13.02	3.77
28	82.94	4.52	.75	2.03	44.00	41.53	1.00	10.00	41.97	16.90	1.61	2.13	35.14	11.56	67.80	18.23	2.41
29	83.25	4.08	.74	2.02	44.00	40.51	1.00	11.00	41.86	16.68	1.74	2.35	35.11	13.05	67.13	17.15	2.68
30	83.57	3.71	.73	2.00	44.00	39.49	1.00	12.00	41.75	16.46	1.88	2.56	35.08	14.53	66.45	16.06	2.95
31	83.89	3.39	.73	1.98	44.00	38.47	1.00	13.00	41.64	16.23	2.02	2.77	35.04	16.02	65.78	14.98	3.22
32	84.21	3.11	.72	1.96	44.00	37.45	1.00	14.00	41.53	16.01	2.15	2.99	35.01	17.51	65.11	13.90	3.48
33	84.54	2.87	.71	1.95	44.00	36.43	1.00	15.00	41.42	15.79	2.29	3.20	34.98	19.00	64.43	12.81	3.75
34	82.90	4.49	.76	2.03	44.00	41.43	1.10	10.00	41.97	16.88	1.63	2.13	35.14	11.92	67.66	18.02	2.40
35	83.31	4.05	.75	2.02	44.00	40.41	1.10	11.00	41.86	16.66	1.77	2.35	35.11	13.40	66.99	16.94	2.66
36	83.62	3.68	.74	2.00	44.00	39.39	1.10	12.00	41.74	16.43	1.90	2.56	35.08	14.89	66.32	15.86	2.93
37	83.94	3.37	.74	1.98	44.00	38.37	1.10	13.00	41.63	16.21	2.04	2.77	35.05	16.38	65.64	14.78	3.20
38	84.27	3.09	.73	1.96	44.00	37.35	1.10	14.00	41.52	15.99	2.18	2.99	35.02	17.87	64.97	13.70	3.46

	LSF	SH	AH	HH	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	C ₄ O
9	84.60	2.86	.72	1.95	44.00	36.32	1.10	15.00	41.41
50	83.05	4.45	.78	2.03	44.00	41.32	1.20	10.00	41.96
1	83.34	4.02	.76	2.02	44.00	40.30	1.20	11.00	41.85
2	83.60	3.66	.75	2.00	44.00	39.28	1.20	12.00	41.74
3	84.00	3.34	.74	1.98	44.00	38.26	1.20	13.00	41.63
4	84.32	3.07	.74	1.96	44.00	37.24	1.20	14.00	41.51
5	84.65	2.84	.73	1.95	44.00	36.22	1.20	15.00	41.40
6	83.10	4.42	.79	2.03	44.00	41.21	1.30	10.00	41.96
7	83.40	3.99	.77	2.01	44.00	40.19	1.30	11.00	41.84
8	83.73	3.63	.76	2.00	44.00	39.17	1.30	12.00	41.73
9	84.05	3.32	.75	1.98	44.00	38.15	1.30	13.00	41.62
520	84.30	3.05	.75	1.96	44.00	37.13	1.30	14.00	41.51
1	84.71	2.82	.74	1.95	44.00	36.11	1.30	15.00	41.40
2	83.16	4.38	.80	2.03	44.00	41.11	1.40	10.00	41.95
3	83.47	3.96	.78	2.01	44.00	40.09	1.40	11.00	41.84
4	83.79	3.61	.77	2.00	44.00	39.06	1.40	12.00	41.73
5	84.11	3.30	.76	1.98	44.00	38.04	1.40	13.00	41.61
6	84.44	3.04	.75	1.96	44.00	37.02	1.40	14.00	41.50
7	84.77	2.80	.75	1.94	44.00	36.00	1.40	15.00	41.39
8	83.21	4.35	.81	2.03	44.00	41.00	1.50	10.00	41.94
9	83.53	3.93	.79	2.01	44.00	39.98	1.50	11.00	41.83
530	83.84	3.58	.78	2.00	44.00	38.96	1.50	12.00	41.72
1	84.17	3.28	.77	1.98	44.00	37.94	1.50	13.00	41.61
2	84.49	3.02	.76	1.96	44.00	36.92	1.50	14.00	41.50
3	84.83	2.79	.75	1.94	44.00	35.90	1.50	15.00	41.38
4	83.27	4.32	.82	2.03	44.00	40.89	1.60	10.00	41.94
5	83.58	3.90	.81	2.01	44.00	39.87	1.60	11.00	41.82
6	83.90	3.56	.79	2.00	44.00	38.85	1.60	12.00	41.71
7	84.22	3.26	.78	1.98	44.00	37.83	1.60	13.00	41.60
8	84.55	3.00	.77	1.96	44.00	36.81	1.60	14.00	41.49
9	84.80	2.77	.76	1.94	44.00	35.79	1.60	15.00	41.38

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Na ₂ O	LS	Sand	Immure
5,76	2,32	3,20	34,98	19,35	64,30	12,61	3,73
6,85	1,65	2,13	35,14	12,28	67,53	17,82	2,38
6,63	1,79	2,35	35,11	13,76	66,85	16,74	2,64
6,41	1,93	2,56	35,08	15,25	66,18	15,66	2,91
6,18	2,07	2,77	35,05	16,74	65,51	14,58	3,18
5,96	2,20	2,99	35,02	18,23	64,84	13,49	3,44
5,74	2,34	3,20	34,99	19,72	64,16	12,41	3,71
6,83	1,68	2,13	35,14	12,63	67,39	17,62	2,36
6,61	1,82	2,35	35,11	14,12	66,72	16,54	2,62
6,38	1,95	2,56	35,08	15,61	66,05	15,46	2,89
6,16	2,09	2,77	35,05	17,10	65,37	14,37	3,16
5,94	2,23	2,99	35,02	18,59	64,70	13,29	3,43
5,71	2,36	3,20	34,99	20,08	64,02	12,20	3,69
6,80	1,70	2,13	35,15	12,99	67,25	17,41	2,34
6,58	1,84	2,35	35,12	14,48	66,58	16,33	2,61
6,36	1,98	2,56	35,09	15,97	65,91	15,25	2,87
6,13	2,11	2,77	35,05	17,45	65,24	14,17	3,14
5,91	2,25	2,99	35,02	18,95	64,56	13,09	3,41
5,69	2,39	3,20	34,99	20,44	63,89	12,00	3,67
6,78	1,73	2,13	35,15	13,35	67,12	17,21	2,32
6,56	1,86	2,35	35,12	14,84	66,45	16,13	2,59
6,33	2,00	2,56	35,09	16,32	65,77	15,05	2,85
6,11	2,14	2,77	35,06	17,81	65,10	13,97	3,12
5,89	2,28	2,99	35,03	19,30	64,43	12,88	3,39
5,66	2,41	3,20	34,99	20,80	63,75	11,80	3,66
6,75	1,75	2,13	35,15	13,71	66,98	17,01	2,30
6,53	1,89	2,35	35,12	15,19	66,31	15,93	2,57
6,31	2,03	2,56	35,09	16,68	65,64	14,85	2,83
6,08	2,16	2,77	35,06	18,17	64,96	13,76	3,10
5,86	2,30	2,99	35,03	19,66	64,29	12,68	3,37
5,64	2,44	3,20	35,00	21,15	63,62	11,59	3,64

	LSF	SH	AM	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO
540	83.32	4.28	.83	2.03	44.00	40.78	1.70	10.00	41.93
1	83.64	3.88	.82	2.01	44.00	39.76	1.70	11.00	41.82
2	83.96	3.53	.80	2.00	44.00	38.74	1.70	12.00	41.71
3	84.28	3.24	.79	1.98	44.00	37.72	1.70	13.00	41.59
4	84.61	2.98	.78	1.96	44.00	36.70	1.70	14.00	41.48
5	84.94	2.76	.77	1.94	44.00	35.68	1.70	15.00	41.37
6	83.38	4.25	.85	2.03	44.00	40.68	1.80	10.00	41.92
7	83.69	3.85	.83	2.01	44.00	39.66	1.80	11.00	41.81
8	84.01	3.51	.81	2.00	44.00	38.64	1.80	12.00	41.70
9	84.34	3.22	.80	1.98	44.00	37.62	1.80	13.00	41.59
550	84.67	2.96	.79	1.96	44.00	36.60	1.80	14.00	41.48
1	85.00	2.74	.78	1.94	44.00	35.58	1.80	15.00	41.36
2	83.43	4.22	.86	2.03	44.00	40.57	1.90	10.00	41.92
3	83.75	3.82	.84	2.01	44.00	39.55	1.90	11.00	41.81
4	84.07	3.48	.82	2.00	44.00	38.53	1.90	12.00	41.69
5	84.39	3.20	.81	1.98	44.00	37.51	1.90	13.00	41.58
6	84.72	2.94	.79	1.96	44.00	36.49	1.90	14.00	41.47
7	85.04	2.72	.78	1.94	44.00	35.47	1.90	15.00	41.36
8	83.49	4.18	.87	2.03	44.00	40.46	2.00	10.00	41.91
9	83.81	3.79	.85	2.01	44.00	39.44	2.00	11.00	41.80
560	84.12	3.46	.83	2.00	44.00	38.42	2.00	12.00	41.69
1	84.44	3.18	.82	1.98	44.00	37.40	2.00	13.00	41.58
2	84.76	2.93	.80	1.96	44.00	36.38	2.00	14.00	41.46
3	85.10	2.71	.79	1.94	44.00	35.36	2.00	15.00	41.35
4	83.54	4.15	.88	2.03	44.00	40.36	2.10	10.00	41.90
5	83.86	3.77	.86	2.01	44.00	39.34	2.10	11.00	41.79
6	84.18	3.44	.84	2.00	44.00	38.32	2.10	12.00	41.68
7	84.51	3.16	.82	1.98	44.00	37.30	2.10	13.00	41.57
8	84.84	2.91	.81	1.96	44.00	36.28	2.10	14.00	41.46
9	85.16	2.69	.80	1.94	44.00	35.26	2.10	15.00	41.34
570	83.60	4.12	.89	2.03	44.00	40.25	2.20	10.00	41.90

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Marl	LS	Sand	Iron Ore
6,73	1,78	2,13	35,15	14,07	66,05	16,81	2,28
6,51	1,91	2,35	35,12	15,55	66,17	15,72	2,55
6,28	2,05	2,56	35,09	17,04	65,50	14,64	2,81
6,06	2,19	2,77	35,06	18,53	64,83	13,56	3,08
5,84	2,32	2,99	35,03	20,02	64,15	12,48	3,35
5,61	2,46	3,20	35,00	21,51	63,48	11,39	3,62
6,70	1,80	2,13	35,16	14,42	66,71	16,60	2,26
6,48	1,94	2,34	35,13	15,91	66,04	15,52	2,53
6,26	2,07	2,56	35,10	17,40	65,37	14,44	2,80
6,04	2,21	2,77	35,06	18,89	64,69	13,36	3,06
5,81	2,35	2,99	35,03	20,38	64,02	12,27	3,33
5,59	2,49	3,20	35,00	21,87	63,34	11,19	3,60
6,68	1,83	2,13	35,16	14,78	66,57	16,40	2,24
6,46	1,96	2,34	35,13	16,27	65,90	15,32	2,51
6,23	2,10	2,56	35,10	17,76	65,23	14,24	2,78
6,01	2,24	2,77	35,07	19,25	64,56	13,15	3,04
5,79	2,37	2,99	35,04	20,74	63,88	12,07	3,31
5,56	2,51	3,20	35,01	22,23	63,21	10,98	3,58
6,65	1,85	2,13	35,16	15,14	66,44	16,20	2,22
6,43	1,99	2,34	35,13	16,63	65,77	15,12	2,49
6,21	2,12	2,56	35,10	18,11	65,09	14,03	2,76
5,99	2,26	2,77	35,07	19,60	64,42	12,95	3,02
5,76	2,40	2,99	35,04	21,10	63,75	11,87	3,29
5,54	2,54	3,20	35,01	22,59	63,07	10,78	3,56
6,63	1,87	2,13	35,17	15,50	66,30	15,99	2,21
6,41	2,01	2,34	35,13	16,98	65,63	14,91	2,47
6,18	2,15	2,56	35,10	18,47	64,96	13,83	2,74
5,96	2,29	2,77	35,07	19,96	64,28	12,75	3,01
5,74	2,42	2,99	35,04	21,45	63,61	11,66	3,27
5,51	2,56	3,20	35,01	22,95	62,94	10,58	3,54
6,61	1,90	2,13	35,17	15,86	66,17	15,79	2,19

LSF	SH	AH	HH	CS	CAS	SA	CAF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Hard	LS	Sand	Iron Ore
1.83.51	3.74	.87	2.01	44.00	39.23	2.20	11.00	41.77	16.38	2.04	2.34	35.14	17.34	65.47	14.71	2.45
1.84.24	3.42	.85	1.99	44.00	38.21	2.20	12.00	41.67	16.16	2.17	2.56	35.11	18.83	64.82	13.63	2.72
1.84.54	3.14	.83	1.98	44.00	37.17	2.20	13.00	41.56	15.99	2.31	2.77	35.07	20.32	64.15	12.54	2.99
1.84.90	2.89	.82	1.96	44.00	36.17	2.20	14.00	41.45	15.71	2.45	2.99	35.04	21.81	63.47	11.46	3.25
1.85.21	2.68	.81	1.94	44.00	35.15	2.20	15.00	41.34	15.49	2.58	3.20	35.01	23.30	62.80	10.37	3.52
1.83.64	4.09	.90	2.03	44.00	40.14	2.30	10.00	41.89	16.58	1.92	2.13	35.17	16.21	66.03	15.59	2.17
1.83.57	3.71	.88	2.01	44.00	39.12	2.30	11.00	41.78	16.36	2.06	2.34	35.14	17.70	65.36	14.51	2.43
1.84.20	3.39	.86	1.99	44.00	38.10	2.30	12.00	41.67	16.12	2.20	2.56	35.11	19.19	64.69	13.42	2.70
1.84.69	3.12	.84	1.98	44.00	37.08	2.30	13.00	41.56	15.91	2.33	2.77	35.08	20.68	64.01	12.34	2.97
1.84.95	2.87	.83	1.96	44.00	36.06	2.30	14.00	41.44	15.69	2.47	2.99	35.05	22.17	63.34	11.26	3.23
1.85.29	2.66	.81	1.94	44.00	35.04	2.30	15.00	41.33	15.46	2.61	3.20	35.02	23.66	62.66	10.17	3.50
1.83.71	4.06	.91	2.03	44.00	40.04	2.40	10.00	41.88	16.56	1.95	2.13	35.17	16.57	65.90	15.39	2.15
1.84.03	3.69	.89	2.01	44.00	39.02	2.40	11.00	41.77	16.33	2.08	2.34	35.14	18.06	65.22	14.30	2.41
1.84.32	3.37	.87	1.99	44.00	38.00	2.40	12.00	41.66	16.11	2.22	2.56	35.11	19.55	64.55	13.22	2.68
1.84.64	3.10	.85	1.98	44.00	36.98	2.40	13.00	41.55	15.89	2.36	2.77	35.08	21.04	63.88	12.14	2.95
1.85.01	2.86	.84	1.96	44.00	35.96	2.40	14.00	41.44	15.66	2.50	2.99	35.05	22.53	63.20	11.05	3.22
1.85.35	2.65	.82	1.94	44.00	34.93	2.40	15.00	41.33	15.44	2.63	3.20	35.02	24.02	62.53	9.97	3.48
1.83.76	4.03	.93	2.03	44.00	39.93	2.50	10.00	41.88	16.52	1.97	2.13	35.18	16.93	65.76	15.18	2.13
1.84.08	3.66	.90	2.01	44.00	38.91	2.50	11.00	41.77	16.31	2.11	2.34	35.14	18.42	65.09	14.10	2.40
1.84.41	3.35	.88	1.99	44.00	37.89	2.50	12.00	41.66	16.08	2.25	2.56	35.11	19.90	64.41	13.02	2.66
1.84.74	3.08	.86	1.98	44.00	36.87	2.50	13.00	41.54	15.86	2.38	2.77	35.08	21.39	63.74	11.94	2.93
1.85.07	2.84	.84	1.96	44.00	35.85	2.50	14.00	41.43	15.64	2.52	2.99	35.05	22.89	63.07	10.85	3.20
1.85.41	2.63	.83	1.94	44.00	34.83	2.50	15.00	41.32	15.41	2.66	3.20	35.02	24.38	62.39	9.77	3.46
1.83.82	4.00	.94	2.03	44.00	39.82	2.60	10.00	41.87	16.51	2.00	2.13	35.18	17.29	65.62	14.98	2.11
1.84.14	3.64	.91	2.01	44.00	38.80	2.60	11.00	41.76	16.28	2.13	2.34	35.15	18.77	64.95	13.90	2.38
1.84.46	3.33	.89	1.99	44.00	37.78	2.60	12.00	41.65	16.06	2.27	2.56	35.12	20.26	64.28	12.82	2.64
1.84.79	3.06	.87	1.98	44.00	36.76	2.60	13.00	41.54	15.84	2.41	2.77	35.09	21.75	63.60	11.73	2.91
1.85.11	2.82	.85	1.96	44.00	35.74	2.60	14.00	41.42	15.61	2.54	2.99	35.05	23.24	62.93	10.65	3.18
1.85.47	2.62	.84	1.94	44.00	34.72	2.60	15.00	41.31	15.39	2.68	3.20	35.02	24.74	62.26	9.56	3.44
1.83.87	3.97	.95	2.03	44.00	39.72	2.70	10.00	41.87	16.48	2.02	2.13	35.18	17.64	65.49	14.78	2.09
1.84.19	3.61	.92	2.01	44.00	38.70	2.70	11.00	41.75	16.26	2.16	2.34	35.15	19.13	64.82	13.70	2.36
1.84.51	3.30	.90	1.99	44.00	37.68	2.70	12.00	41.64	16.04	2.29	2.56	35.12	20.62	64.14	12.61	2.62

LSF	SH	AH	HH	C3S	C2S	C3A	C4AF	C4D	SiO2	Al2O3	Fe2O3	LOI	Hard	LS	Sand	Ironore
384.86	3.04	.88	1.98	44.00	36.65	2.70	13.00	41.53	15.81	2.43	2.77	35.09	22.11	63.47	11.53	2.89
485.19	2.81	.86	1.96	44.00	35.63	2.76	14.00	41.42	15.59	2.57	2.99	35.06	23.60	62.79	10.44	3.16
585.51	2.60	.85	1.94	44.00	34.61	2.70	15.00	41.31	15.36	2.71	3.20	35.03	25.10	62.12	9.36	3.43
683.92	3.94	.96	2.03	44.00	39.41	2.80	10.00	41.86	16.46	2.04	2.13	35.18	18.00	65.35	14.57	2.07
784.26	3.59	.93	2.01	44.00	38.59	2.80	11.00	41.75	16.23	2.18	2.34	35.15	19.49	64.68	13.49	2.34
884.68	3.28	.91	1.99	44.00	37.57	2.80	12.00	41.64	16.01	2.32	2.56	35.12	20.98	64.01	12.41	2.60
984.91	3.02	.89	1.98	44.00	36.55	2.80	13.00	41.52	15.79	2.46	2.77	35.09	22.47	63.33	11.33	2.87
6085.26	2.79	.87	1.96	44.00	35.53	2.80	14.00	41.41	15.56	2.59	2.99	35.06	23.96	62.66	10.24	3.14
185.59	2.59	.85	1.94	44.00	34.51	2.80	15.00	41.30	15.34	2.73	3.20	35.03	25.45	61.98	9.16	3.41
283.98	3.91	.97	2.03	44.00	39.50	2.90	10.00	41.85	16.43	2.07	2.13	35.19	18.36	65.22	14.37	2.05
384.31	3.56	.94	2.01	44.00	38.48	2.90	11.00	41.74	16.21	2.21	2.34	35.15	19.85	64.54	13.29	2.32
484.64	3.26	.92	1.99	44.00	37.46	2.90	12.00	41.63	15.99	2.34	2.56	35.12	21.34	63.87	12.21	2.59
584.97	3.00	.89	1.98	44.00	36.44	2.90	13.00	41.52	15.76	2.48	2.77	35.09	22.83	63.20	11.12	2.85
685.30	2.77	.88	1.96	44.00	35.42	2.90	14.00	41.41	15.54	2.62	2.99	35.06	24.32	62.52	10.04	3.12
785.66	2.57	.86	1.94	44.00	34.40	2.90	15.00	41.29	15.31	2.76	3.20	35.03	25.81	61.85	8.95	3.39
884.04	3.89	.98	2.03	44.00	39.43	3.00	10.00	41.85	16.41	2.09	2.13	35.19	18.72	65.08	14.17	2.03
984.36	3.54	.95	2.01	44.00	38.37	3.00	11.00	41.73	16.18	2.23	2.34	35.16	20.20	64.41	13.09	2.30
6084.69	3.24	.93	1.99	44.00	37.35	3.00	12.00	41.62	15.96	2.37	2.56	35.13	21.69	63.74	12.00	2.57
185.09	2.98	.90	1.98	44.00	36.33	3.00	13.00	41.51	15.74	2.50	2.77	35.10	23.18	63.06	10.92	2.83
285.34	2.76	.88	1.96	44.00	35.31	3.00	14.00	41.40	15.51	2.64	2.99	35.06	24.68	62.39	9.84	3.10
385.71	2.56	.87	1.94	44.00	34.29	3.00	15.00	41.29	15.29	2.78	3.20	35.03	26.17	61.71	8.75	3.37
484.18	3.86	.99	2.03	44.00	39.29	3.10	10.00	41.84	16.38	2.12	2.13	35.19	19.07	64.94	13.97	2.01
584.49	3.61	.96	2.01	44.00	38.27	3.10	11.00	41.73	16.16	2.25	2.34	35.16	20.56	64.27	12.88	2.28
684.76	3.22	.94	1.99	44.00	37.25	3.10	12.00	41.62	15.94	2.39	2.56	35.13	22.05	63.60	11.80	2.55
785.08	2.96	.91	1.98	44.00	36.23	3.10	13.00	41.50	15.71	2.53	2.77	35.10	23.54	62.93	10.72	2.81
885.44	2.74	.89	1.96	44.00	35.21	3.10	14.00	41.38	15.49	2.67	2.99	35.07	25.03	62.25	9.63	3.08
985.74	2.54	.88	1.94	44.00	34.19	3.10	15.00	41.26	15.27	2.80	3.20	35.04	26.53	61.58	8.55	3.35
63084.16	3.83	1.01	2.03	44.00	39.19	3.20	10.00	41.83	16.36	2.14	2.13	35.19	19.49	64.81	13.76	2.00
184.44	3.49	.97	2.01	44.00	38.16	3.20	11.00	41.72	16.13	2.28	2.34	35.16	20.92	64.14	12.68	2.26
284.81	3.20	.94	1.99	44.00	37.14	3.20	12.00	41.61	15.91	2.42	2.56	35.13	22.41	63.46	11.60	2.53
385.14	2.95	.92	1.97	44.00	36.12	3.20	13.00	41.50	15.69	2.55	2.77	35.10	23.90	62.79	10.51	2.80

LSF	SH	AH	MH	C3S	C2S	A3A	C4AF	CaO	SO2	Al2O3	Fe2O3	LOI	Harl	LS	Sand	Iron Ore
4	85.40	2.72	.90	1.96	44.00	35.10	3.20	14.00	41.37	15.46	2.69	2.94	25.37	62.12	7.43	3.06
5	85.82	2.53	.88	1.94	44.00	34.08	3.20	15.00	41.27	15.24	2.63	3.20	26.89	61.44	8.34	3.33
6	84.21	3.40	1.02	2.03	44.00	39.07	3.30	10.00	41.83	16.32	2.17	2.13	19.79	64.67	13.56	1.98
7	84.54	3.47	.98	2.01	44.00	38.05	3.30	11.00	41.72	16.11	2.30	2.34	21.28	64.00	12.48	2.24
8	84.94	3.18	.95	1.99	44.00	37.03	3.30	12.00	41.60	15.89	2.44	2.56	22.77	63.33	11.40	2.51
9	85.20	2.93	.93	1.97	44.00	36.01	3.30	13.00	41.49	15.66	2.58	2.77	24.26	62.65	10.31	2.78
640	85.54	2.71	.91	1.96	44.00	34.99	3.30	14.00	41.38	15.44	2.72	2.99	25.75	61.98	9.23	3.04
1	85.88	2.51	.89	1.94	44.00	33.97	3.30	15.00	41.27	15.22	2.85	3.20	27.24	61.30	8.14	3.31
2	84.24	3.77	1.03	2.03	44.00	38.97	3.40	10.00	41.82	16.31	2.19	2.13	20.15	64.54	13.36	1.96
3	84.59	3.44	.99	2.01	44.00	37.95	3.40	11.00	41.71	16.08	2.33	2.34	21.64	63.87	12.28	2.22
4	84.94	3.16	.96	1.99	44.00	36.93	3.40	12.00	41.60	15.86	2.46	2.56	23.12	63.19	11.19	2.49
5	85.24	2.91	.94	1.97	44.00	35.91	3.40	13.00	41.49	15.64	2.60	2.77	24.62	62.52	10.11	2.76
6	85.60	2.69	.92	1.96	44.00	34.89	3.40	14.00	41.37	15.41	2.74	2.99	26.11	61.84	9.02	3.02
7	85.94	2.50	.90	1.94	44.00	33.87	3.40	15.00	41.26	15.19	2.88	3.20	27.60	61.17	7.94	3.29
8	84.32	3.75	1.04	2.03	44.00	38.86	3.50	10.00	41.81	16.28	2.22	2.13	20.50	64.40	13.16	1.94
9	84.65	3.42	1.00	2.01	44.00	37.84	3.50	11.00	41.70	16.06	2.35	2.34	21.99	63.73	12.07	2.20
650	84.98	3.14	.97	1.99	44.00	36.82	3.50	12.00	41.59	15.84	2.49	2.56	23.48	63.06	10.99	2.47
1	85.33	2.89	.95	1.97	44.00	35.80	3.50	13.00	41.48	15.61	2.63	2.77	24.97	62.38	9.91	2.74
2	85.66	2.68	.93	1.96	44.00	34.78	3.50	14.00	41.37	15.39	2.76	2.99	26.47	61.71	8.82	3.01
3	86.00	2.48	.91	1.94	44.00	33.76	3.50	15.00	41.26	15.17	2.90	3.20	27.96	61.03	7.74	3.27
4	83.14	4.88	.64	2.05	46.00	40.60	.60	10.00	42.11	17.02	1.36	2.13	8.01	69.33	20.06	2.60
5	83.44	4.37	.64	2.03	46.00	39.58	.00	11.00	42.00	16.80	1.50	2.34	9.50	68.65	18.98	2.87
6	83.75	3.95	.64	2.02	46.00	38.56	.00	12.00	41.89	16.58	1.63	2.56	10.98	67.98	17.90	3.13
7	84.08	3.60	.64	2.00	46.00	37.54	.00	13.00	41.78	16.36	1.77	2.77	12.47	67.31	16.82	3.40
8	84.40	3.30	.64	1.98	46.00	36.52	.00	14.00	41.66	16.14	1.91	2.99	13.95	66.64	15.74	3.67
9	84.71	3.03	.64	1.96	46.00	35.50	.00	15.00	41.55	15.91	2.04	3.20	15.44	65.97	14.65	3.94
660	83.18	4.84	.65	2.05	46.00	40.49	.10	10.00	42.10	17.00	1.38	2.13	8.37	69.19	19.86	2.58
1	83.49	4.34	.65	2.03	46.00	39.47	.10	11.00	41.99	16.78	1.52	2.34	9.85	68.52	18.78	2.85
2	83.81	3.93	.65	2.02	46.00	38.45	.10	12.00	41.88	16.55	1.66	2.56	11.34	67.85	17.70	3.12
3	84.14	3.57	.65	2.00	46.00	37.43	.10	13.00	41.77	16.33	1.79	2.77	12.83	67.18	16.62	3.38
4	84.46	3.27	.65	1.98	46.00	36.41	.10	14.00	41.66	16.11	1.93	2.99	14.31	66.50	15.53	3.65

LSF	SH	AM	HH	C3S	C2S	C3A	C4AF	CaO	SiO2	Al2O3	Fe2O3	LOI	Harl	LS	Sand	Iron Ore
5.84.79	3.01	.65	1.96	46.00	35.39	.10	15.00	41.55	15.88	2.07	3.20	35.02	15.80	69.83	14.45	34.92
6.83.24	4.80	.66	2.05	46.00	40.39	.20	10.00	42.10	16.98	1.41	2.13	35.17	8.73	69.05	19.65	27.56
7.83.54	4.31	.66	2.03	46.00	39.37	.20	11.00	41.99	16.75	1.55	2.34	35.14	10.21	68.38	18.57	27.83
8.83.87	3.90	.66	2.02	46.00	38.34	.23	12.00	41.88	16.53	1.68	2.56	35.11	11.70	67.71	17.49	31.10
9.84.19	3.55	.66	2.00	46.00	37.32	.20	13.00	41.76	16.31	1.82	2.77	35.08	13.18	67.04	16.41	31.36
10.84.51	3.25	.65	1.98	46.00	36.30	.20	14.00	41.65	16.08	1.96	2.99	35.05	14.67	66.37	15.33	31.63
11.84.84	2.99	.65	1.96	46.00	35.28	.20	15.00	41.54	15.86	2.09	3.20	35.02	16.16	65.69	14.25	31.90
12.83.20	4.76	.67	2.05	46.00	40.28	.30	10.00	42.09	16.95	1.43	2.13	35.18	9.09	68.92	19.45	27.54
13.83.66	4.27	.67	2.03	46.00	39.26	.30	11.00	41.98	16.73	1.57	2.34	35.15	10.57	68.25	18.37	27.81
14.83.99	3.87	.67	2.02	46.00	38.24	.30	12.00	41.87	16.50	1.71	2.56	35.12	12.06	67.58	17.29	27.08
15.84.24	3.53	.66	2.00	46.00	37.22	.30	13.00	41.76	16.28	1.84	2.77	35.08	13.54	66.90	16.21	31.34
16.84.57	3.23	.66	1.98	46.00	36.20	.30	14.00	41.65	16.06	1.98	2.99	35.05	15.03	66.23	15.13	31.61
17.84.90	2.98	.66	1.94	46.00	35.18	.30	15.00	41.53	15.83	2.12	3.20	35.02	16.52	65.56	14.04	31.88
18.83.34	4.72	.68	2.03	46.00	40.17	.40	10.00	42.09	16.93	1.46	2.13	35.18	9.45	68.78	19.25	27.52
19.83.64	4.24	.68	2.03	46.00	39.15	.40	11.00	41.97	16.70	1.59	2.34	35.15	10.93	68.11	18.17	27.79
20.83.98	3.84	.68	2.02	46.00	38.13	.40	12.00	41.86	16.48	1.73	2.56	35.12	12.41	67.44	17.09	27.06
21.84.31	3.50	.67	2.00	46.00	37.11	.40	13.00	41.75	16.26	1.87	2.77	35.09	13.90	66.77	16.01	27.33
22.84.63	3.21	.67	1.98	46.00	36.09	.40	14.00	41.64	16.03	2.01	2.99	35.06	15.39	66.09	14.92	27.59
23.84.94	2.96	.67	1.96	46.00	35.07	.40	15.00	41.53	15.81	2.14	3.20	35.02	16.88	65.42	13.84	27.86
24.83.48	4.68	.70	2.05	46.00	40.06	.50	10.00	42.08	16.90	1.48	2.13	35.18	9.80	68.65	19.05	27.51
25.83.71	4.21	.69	2.03	46.00	39.04	.50	11.00	41.97	16.68	1.62	2.34	35.15	11.29	67.97	17.97	27.77
26.84.01	3.81	.69	2.02	46.00	38.02	.50	12.00	41.86	16.46	1.76	2.56	35.12	12.77	67.30	16.89	27.04
27.84.34	3.48	.68	2.00	46.00	37.00	.50	13.00	41.74	16.23	1.89	2.77	35.09	14.26	66.63	15.80	27.31
28.84.68	3.19	.68	1.98	46.00	35.98	.50	14.00	41.63	16.01	2.03	2.99	35.06	15.75	65.96	14.72	27.57
29.85.02	2.94	.68	1.96	46.00	34.96	.50	15.00	41.52	15.79	2.17	3.20	35.03	17.24	65.29	13.64	27.84
30.85.44	4.64	.71	2.05	46.00	39.96	.60	10.00	42.07	16.88	1.51	2.13	35.18	10.16	68.51	18.76	27.49
31.83.77	4.18	.70	2.03	46.00	38.94	.60	11.00	41.96	16.65	1.64	2.34	35.15	11.65	67.84	17.68	27.75
32.84.09	3.79	.70	2.02	46.00	37.92	.60	12.00	41.85	16.43	1.78	2.56	35.12	13.13	67.17	16.60	27.02
33.84.41	3.46	.69	2.00	46.00	36.90	.60	13.00	41.74	16.21	1.92	2.77	35.09	14.62	66.50	15.60	27.29
34.84.74	3.17	.69	1.98	46.00	35.88	.60	14.00	41.63	15.98	2.05	2.99	35.06	16.11	65.82	14.52	27.55
35.85.08	2.92	.68	1.96	46.00	34.86	.60	15.00	41.51	15.76	2.19	3.20	35.03	17.59	65.15	13.43	27.82

LSF	SH	AH	HH	SS	CS	CA	CAF	CAO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Hard	LS	Sand	Iron Ore
493.51	4.60	.72	2.05	45.00	39.85	.70	10.00	42.07	16.85	1.53	2.13	35.19	10.52	68.37	18.64	2.47
393.87	4.15	.71	2.03	46.00	38.83	.70	11.00	41.95	16.63	1.67	2.34	35.16	12.00	67.70	17.56	2.73
804.14	3.76	.71	2.01	46.00	37.81	.70	12.00	41.84	16.41	1.80	2.56	35.13	13.49	67.03	16.48	3.00
904.47	3.43	.70	2.00	46.00	36.79	.70	13.00	41.73	16.18	1.94	2.77	35.09	14.98	66.36	15.40	3.27
8084.80	3.15	.70	1.98	46.00	35.77	.70	14.00	41.62	15.96	2.08	2.99	35.06	16.46	65.69	14.31	3.54
185.17	2.90	.69	1.96	46.00	34.75	.70	15.00	41.51	15.74	2.22	3.20	35.03	17.95	65.01	13.23	3.80
283.54	4.57	.73	2.05	46.00	39.74	.80	10.00	42.06	16.83	1.56	2.13	35.19	10.88	68.24	18.44	2.45
383.84	4.11	.72	2.03	46.00	38.72	.80	11.00	41.95	16.60	1.69	2.34	35.16	12.36	67.57	17.36	2.72
494.20	3.73	.71	2.01	46.00	37.70	.80	12.00	41.84	16.38	1.83	2.56	35.13	13.85	66.90	16.28	2.98
584.57	3.41	.71	2.00	46.00	36.68	.80	13.00	41.72	16.16	1.97	2.77	35.10	15.33	66.22	15.19	3.25
684.64	2.89	.70	1.98	46.00	35.66	.80	14.00	41.61	15.92	2.10	2.99	35.07	16.82	65.55	14.11	3.52
785.19	4.53	.74	1.96	46.00	34.64	.80	15.00	41.50	15.71	2.24	3.20	35.03	18.31	64.88	13.03	3.78
883.62	4.53	.74	2.05	46.00	39.64	.90	10.00	42.05	16.80	1.58	2.13	35.16	11.24	68.10	18.23	2.43
983.94	4.08	.73	2.03	46.00	38.62	.90	11.00	41.94	16.58	1.72	2.34	35.16	12.72	67.43	17.15	2.70
1094.26	3.71	.72	2.01	46.00	37.60	.90	12.00	41.83	16.36	1.85	2.56	35.13	14.20	66.76	16.07	2.96
184.58	3.39	.72	2.00	46.00	36.58	.90	13.00	41.72	16.13	1.99	2.77	35.10	15.69	66.09	14.99	3.23
284.99	3.11	.71	1.98	46.00	35.56	.90	14.00	41.61	15.91	2.13	2.99	35.07	17.18	65.41	13.91	3.50
385.25	2.87	.71	1.96	46.00	34.54	.90	15.00	41.49	15.69	2.26	3.20	35.04	18.67	64.74	12.82	3.76
483.67	4.49	.75	2.05	46.00	39.53	1.00	10.00	42.05	16.78	1.60	2.13	35.19	11.59	67.97	18.03	2.41
583.98	4.05	.74	2.03	46.00	38.51	1.00	11.00	41.94	16.55	1.74	2.34	35.16	13.08	67.30	16.95	2.68
684.31	3.68	.73	2.01	46.00	37.49	1.00	12.00	41.82	16.33	1.88	2.56	35.13	14.56	66.62	15.87	2.94
784.64	3.36	.73	2.00	46.00	36.47	1.00	13.00	41.71	16.11	2.01	2.77	35.10	16.05	65.95	14.79	3.21
884.97	3.09	.72	1.98	46.00	35.45	1.00	14.00	41.60	15.88	2.15	2.99	35.07	17.54	65.28	13.71	3.48
985.31	2.85	.71	1.96	46.00	34.43	1.00	15.00	41.49	15.66	2.29	3.20	35.04	19.03	64.60	12.62	3.75
2883.74	4.49	.76	2.05	46.00	39.42	1.10	10.00	42.04	16.75	1.63	2.13	35.20	11.95	67.83	17.83	2.39
184.05	4.02	.75	2.03	46.00	38.40	1.10	11.00	41.93	16.53	1.77	2.34	35.17	13.43	67.16	16.75	2.66
184.37	3.66	.74	2.01	46.00	37.38	1.10	12.00	41.82	16.31	1.90	2.56	35.14	14.92	66.49	15.67	2.92
384.70	3.34	.74	2.00	46.00	36.36	1.10	13.00	41.71	16.08	2.04	2.77	35.10	16.41	65.82	14.59	3.19
485.07	3.07	.73	1.98	46.00	35.34	1.10	14.00	41.59	15.86	2.18	2.99	35.07	17.90	65.14	13.50	3.46
585.37	2.84	.72	1.96	46.00	34.32	1.10	15.00	41.48	15.64	2.31	3.20	35.04	19.39	64.47	12.42	3.73
683.70	4.42	.78	2.05	46.00	39.32	1.20	10.00	42.03	16.73	1.65	2.13	35.20	12.31	67.69	17.62	2.37
784.10	3.99	.76	2.03	46.00	38.30	1.20	11.00	41.92	16.50	1.79	2.34	35.17	13.79	67.02	16.54	2.64

LSF	SH	AH	HH	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Marl	LS	Sand	Iron Ore
8184.44	3.63	.75	2.01	46.00	37.28	1.20	12.00	41.81	16.28	1.93	2.56	35.14	15.28	66.35	15.46	2.91
9184.74	3.32	.74	2.00	46.00	36.26	1.20	13.00	41.70	16.06	2.06	2.77	35.11	16.77	65.68	14.38	3.17
39085.00	3.05	.74	1.98	46.00	35.24	1.20	14.00	41.59	15.83	2.20	2.99	35.08	18.25	65.01	13.30	3.44
1185.43	2.82	.73	1.96	46.00	34.21	1.20	15.00	41.48	15.61	2.34	3.20	35.05	19.74	64.33	12.22	3.71
2183.84	4.39	.79	2.05	46.00	39.21	1.30	10.00	42.03	16.70	1.68	2.13	35.20	12.67	67.56	17.42	2.35
3184.16	3.96	.77	2.03	46.00	38.15	1.30	11.00	41.92	16.48	1.81	2.34	35.17	14.15	66.89	16.34	2.62
4184.44	3.61	.76	2.01	46.00	37.17	1.30	12.00	41.80	16.26	1.95	2.56	35.14	15.64	66.22	15.26	2.89
5184.81	3.30	.75	2.00	46.00	36.15	1.30	13.00	41.69	16.03	2.09	2.77	35.11	17.12	65.54	14.18	3.15
6185.15	3.03	.75	1.98	46.00	35.13	1.32	14.00	41.58	15.81	2.23	2.99	35.08	18.61	64.87	13.10	3.42
7185.49	2.80	.74	1.96	46.00	34.11	1.30	15.00	41.47	15.59	2.36	3.20	35.05	20.10	64.20	12.01	3.69
8183.89	4.35	.80	2.05	46.00	39.10	1.40	10.00	42.02	16.68	1.70	2.13	35.21	13.02	67.42	17.22	2.33
9184.22	3.94	.78	2.03	46.00	38.08	1.40	11.00	41.91	16.45	1.84	2.34	35.17	14.51	66.75	16.14	2.60
39084.54	3.58	.77	2.01	46.00	37.06	1.40	12.00	41.80	16.23	1.98	2.56	35.14	15.99	66.08	15.06	2.87
1184.87	3.28	.76	2.00	46.00	36.04	1.40	13.00	41.69	16.01	2.11	2.77	35.11	17.48	65.41	13.98	3.13
2185.20	3.01	.75	1.98	46.00	35.02	1.40	14.00	41.57	15.79	2.25	2.99	35.08	18.97	64.73	12.89	3.40
3185.54	2.78	.75	1.96	46.00	34.00	1.42	15.00	41.46	15.56	2.39	3.20	35.05	20.46	64.06	11.81	3.67
4183.95	4.32	.81	2.05	46.00	39.00	1.50	10.00	42.01	16.65	1.73	2.13	35.21	13.38	67.29	17.02	2.32
5184.27	3.91	.79	2.03	46.00	37.98	1.50	11.00	41.90	16.43	1.86	2.34	35.18	14.87	66.62	15.94	2.58
6184.60	3.56	.78	2.01	46.00	36.96	1.52	12.00	41.79	16.21	2.00	2.56	35.15	16.35	65.94	14.86	2.85
7184.93	3.26	.77	2.00	46.00	35.93	1.50	13.00	41.68	15.98	2.14	2.77	35.11	17.84	65.27	13.77	3.12
8185.24	3.00	.76	1.98	46.00	34.91	1.50	14.00	41.57	15.76	2.27	2.99	35.08	19.33	64.60	12.69	3.38
9185.60	2.77	.75	1.96	46.00	33.89	1.50	15.00	41.46	15.54	2.41	3.20	35.05	20.82	63.92	11.61	3.65
39084.01	4.29	.82	2.05	46.00	38.89	1.60	10.00	42.01	16.63	1.75	2.13	35.21	13.74	67.15	16.81	2.30
1184.32	3.88	.81	2.03	46.00	37.87	1.60	11.00	41.90	16.40	1.89	2.34	35.18	15.22	66.48	15.73	2.56
2184.65	3.53	.79	2.01	46.00	36.85	1.60	12.00	41.79	16.18	2.02	2.56	35.15	16.71	65.81	14.65	2.83
3184.98	3.24	.78	1.99	46.00	35.83	1.60	13.00	41.67	15.96	2.16	2.77	35.12	18.20	65.14	13.57	3.10
4185.32	2.98	.77	1.98	46.00	34.81	1.60	14.00	41.56	15.74	2.30	2.99	35.09	19.69	64.46	12.49	3.36
5185.64	4.25	.83	2.05	46.00	38.79	1.60	15.00	41.45	15.51	2.44	3.20	35.06	21.18	63.79	11.40	3.63
6184.04	4.25	.83	2.05	46.00	38.78	1.70	10.00	42.00	16.60	1.77	2.13	35.21	14.10	67.02	16.61	2.28
7184.34	3.85	.82	2.03	46.00	37.76	1.70	11.00	41.89	16.38	1.91	2.34	35.18	15.58	66.34	15.53	2.54
8184.71	3.51	.80	2.01	46.00	36.74	1.70	12.00	41.78	16.16	2.05	2.56	35.15	17.07	65.67	14.45	2.81
9185.04	3.21	.79	1.99	46.00	35.72	1.70	13.00	41.67	15.93	2.19	2.77	35.12	18.56	65.00	13.37	3.08

	LSF	SH	AH	HH	CS	CS	CA	CAF	CAO	SIO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Hail	LS	Sand	ImmDir
60	85.32	2.96	.78	1.98	46.00	34.70	1.70	14.00	41.56	15.71	2.32	2.99	35.05	20.05	64.33	12.28	3.34
1	85.72	2.74	.77	1.96	46.00	33.68	1.70	15.00	41.44	15.49	2.46	3.20	35.06	21.54	63.65	11.20	3.61
2	84.12	4.22	.85	2.05	46.00	38.68	1.83	10.00	42.00	16.58	1.80	2.13	35.22	14.45	66.88	16.91	2.26
3	84.44	3.82	.83	2.03	46.00	37.65	1.80	11.00	41.88	16.36	1.94	2.34	35.18	15.94	66.71	15.33	2.52
4	84.77	3.42	.81	2.01	46.00	36.63	1.80	12.00	41.77	16.13	2.07	2.56	35.15	17.43	65.54	14.25	2.79
5	85.10	3.19	.80	1.99	46.00	35.61	1.80	13.00	41.66	15.91	2.21	2.77	35.12	18.91	64.86	13.16	3.06
6	85.44	2.94	.79	1.98	46.00	34.59	1.80	14.00	41.55	15.69	2.35	2.99	35.09	20.40	64.19	12.08	3.33
7	85.72	2.72	.78	1.96	46.00	33.57	1.80	15.00	41.44	15.46	2.48	3.20	35.06	21.89	63.52	11.00	3.59
8	84.17	4.19	.86	2.05	46.00	38.57	1.90	10.00	41.99	16.55	1.82	2.13	35.22	14.81	66.74	16.21	2.24
9	84.56	3.80	.84	2.03	46.00	37.55	1.90	11.00	41.88	16.33	1.96	2.34	35.19	16.30	66.07	15.12	2.51
870	84.84	3.46	.82	2.01	46.00	36.53	1.90	12.00	41.77	16.11	2.10	2.56	35.16	17.78	65.40	14.04	2.77
1	85.14	3.17	.81	1.99	46.00	35.51	1.90	13.00	41.65	15.88	2.23	2.77	35.12	19.27	64.73	12.96	3.04
2	85.54	2.92	.79	1.98	46.00	34.49	1.90	14.00	41.54	15.66	2.37	2.99	35.09	20.76	64.05	11.88	3.31
3	85.84	2.70	.78	1.96	46.00	33.47	1.90	15.00	41.43	15.44	2.51	3.20	35.06	22.25	63.38	10.79	3.57
4	84.21	4.16	.87	2.05	46.00	38.46	2.00	10.00	41.98	16.53	1.85	2.13	35.22	15.17	66.61	16.00	2.22
5	84.55	3.77	.85	2.03	46.00	37.44	2.00	11.00	41.87	16.31	1.98	2.34	35.19	16.65	65.94	14.92	2.49
6	84.88	3.44	.83	2.01	46.00	36.42	2.00	12.00	41.76	16.08	2.12	2.56	35.16	18.14	65.26	13.84	2.75
7	85.22	3.15	.82	1.99	46.00	35.40	2.00	13.00	41.65	15.86	2.26	2.77	35.13	19.63	64.59	12.76	3.02
8	85.56	2.91	.80	1.98	46.00	34.38	2.00	14.00	41.54	15.64	2.40	2.99	35.10	21.12	63.92	11.68	3.29
9	85.94	2.69	.79	1.96	46.00	33.36	2.00	15.00	41.42	15.41	2.53	3.20	35.07	22.61	63.24	10.59	3.55
880	84.29	4.13	.88	2.05	46.00	38.35	2.10	10.00	41.98	16.50	1.87	2.13	35.22	15.53	66.47	15.80	2.20
1	84.61	3.74	.86	2.03	46.00	37.33	2.10	11.00	41.87	16.28	2.01	2.34	35.19	17.01	65.80	14.72	2.47
2	84.94	3.41	.84	2.01	46.00	36.31	2.10	12.00	41.75	16.06	2.15	2.56	35.16	18.50	65.13	13.64	2.73
3	85.27	3.13	.82	1.99	46.00	35.29	2.10	13.00	41.64	15.82	2.28	2.77	35.13	19.99	64.46	12.56	3.00
4	85.61	2.89	.81	1.98	46.00	34.27	2.10	14.00	41.53	15.61	2.42	2.99	35.10	21.48	63.78	11.47	3.27
5	85.96	2.67	.80	1.96	46.00	33.25	2.10	15.00	41.42	15.39	2.56	3.20	35.07	22.97	63.11	10.39	3.54
6	84.34	4.09	.89	2.05	46.00	38.25	2.20	10.00	41.97	16.48	1.90	2.13	35.23	15.88	66.34	15.60	2.18
7	84.67	3.71	.87	2.03	46.00	37.23	2.20	11.00	41.86	16.26	2.03	2.34	35.19	17.37	65.67	14.52	2.45
8	85.01	3.39	.85	2.01	46.00	36.21	2.20	12.00	41.75	16.03	2.17	2.56	35.16	18.86	64.99	13.44	2.71
9	85.33	3.11	.83	1.99	46.00	35.19	2.20	13.00	41.64	15.81	2.31	2.77	35.13	20.35	64.32	12.35	2.98
890	85.67	2.87	.82	1.98	46.00	34.17	2.20	14.00	41.52	15.59	2.44	2.99	35.10	21.84	63.65	11.27	3.25

LSF	SH	AH	HH	CS	CS	CA	CAF	CO	SO ₂	ALD ₃	Fe ₂ O ₃	LOI	Na ₂ LS	Sand	From Ore	
1 86.60	2.66	.81	1.96	46.00	33.15	2.20	15.00	41.41	15.36	2.58	3.20	35.07	23.33	62.97	10.18	3.52
2 84.40	4.06	.90	2.05	46.00	38.14	2.30	10.00	41.96	16.45	1.92	2.13	35.23	16.24	66.20	15.39	2.16
3 84.70	3.69	.88	2.03	46.00	37.12	2.30	11.00	41.85	16.23	2.06	2.34	35.20	17.73	65.53	14.31	2.43
4 85.05	3.37	.86	2.01	46.00	36.10	2.30	12.00	41.74	16.01	2.19	2.56	35.17	19.21	64.86	13.23	2.70
5 85.30	3.09	.84	1.99	46.00	35.08	2.30	13.00	41.63	15.79	2.33	2.77	35.14	20.70	64.18	12.15	2.96
6 85.70	2.85	.83	1.98	46.00	34.06	2.30	14.00	41.52	15.54	2.47	2.99	35.10	22.19	63.51	11.07	3.23
7 86.00	2.64	.81	1.96	46.00	33.04	2.30	15.00	41.41	15.34	2.61	3.20	35.07	23.68	62.84	9.98	3.50
8 84.40	4.03	.81	2.05	46.00	38.03	2.40	10.00	41.96	16.43	1.95	2.13	35.23	16.60	66.07	15.19	2.14
9 84.70	3.66	.89	2.03	46.00	37.01	2.40	11.00	41.85	16.21	2.08	2.34	35.20	18.08	65.39	14.11	2.41
10 85.11	3.35	.87	2.01	46.00	35.99	2.40	12.00	41.73	15.98	2.22	2.56	35.17	19.57	64.72	13.03	2.68
1 85.40	3.07	.85	1.99	46.00	34.97	2.40	13.00	41.62	15.76	2.36	2.77	35.14	21.06	64.05	11.95	2.94
2 85.70	2.84	.84	1.98	46.00	33.95	2.40	14.00	41.51	15.54	2.49	2.99	35.11	22.55	63.38	10.86	3.21
3 86.14	2.63	.82	1.96	46.00	32.93	2.40	15.00	41.40	15.31	2.63	3.20	35.08	24.04	62.70	9.78	3.48
4 84.51	4.00	.93	2.05	46.00	37.93	2.50	10.00	41.95	16.40	1.97	2.13	35.23	16.96	65.93	14.99	2.13
5 84.84	3.64	.90	2.03	46.00	36.91	2.50	11.00	41.84	16.18	2.11	2.34	35.20	18.44	65.26	13.91	2.39
6 85.17	3.32	.88	2.01	46.00	35.89	2.50	12.00	41.73	15.96	2.24	2.56	35.17	19.93	64.59	12.83	2.66
7 85.51	3.05	.86	1.99	46.00	34.87	2.50	13.00	41.62	15.74	2.38	2.77	35.14	21.42	63.91	11.74	2.92
8 85.80	2.82	.84	1.97	46.00	33.85	2.50	14.00	41.50	15.51	2.52	2.99	35.11	22.91	63.24	10.66	3.19
9 86.20	2.61	.83	1.96	46.00	32.83	2.50	15.00	41.39	15.29	2.66	3.20	35.08	24.40	62.57	9.58	3.46
10 84.50	3.97	.94	2.05	46.00	37.82	2.60	10.00	41.94	16.38	1.99	2.13	35.24	17.31	65.79	14.79	2.11
1 84.90	3.61	.91	2.03	46.00	36.80	2.60	11.00	41.83	16.16	2.13	2.34	35.20	18.80	65.12	13.71	2.37
2 85.20	3.30	.89	2.01	46.00	35.78	2.60	12.00	41.72	15.93	2.27	2.56	35.17	20.29	64.45	12.62	2.64
3 85.57	3.04	.87	1.99	46.00	34.76	2.60	13.00	41.61	15.71	2.40	2.77	35.14	21.78	63.78	11.54	2.91
4 85.91	2.80	.85	1.97	46.00	33.74	2.60	14.00	41.50	15.49	2.54	2.99	35.11	23.27	63.10	10.46	3.17
5 86.24	2.60	.84	1.96	46.00	32.72	2.60	15.00	41.39	15.26	2.68	3.20	35.08	24.76	62.43	9.37	3.44
6 84.60	3.94	.95	2.05	46.00	37.71	2.70	10.00	41.94	16.35	2.02	2.13	35.24	17.67	65.66	14.58	2.09
7 84.90	3.59	.92	2.03	46.00	36.69	2.70	11.00	41.83	16.13	2.16	2.34	35.21	19.16	64.99	13.50	2.35
8 85.20	3.28	.90	2.01	46.00	35.67	2.70	12.00	41.72	15.91	2.29	2.56	35.18	20.64	64.31	12.42	2.62
9 85.60	3.02	.88	1.99	46.00	34.65	2.70	13.00	41.60	15.69	2.43	2.77	35.15	22.13	63.64	11.34	2.89
10 85.90	2.79	.86	1.97	46.00	33.63	2.70	14.00	41.49	15.46	2.57	2.99	35.11	23.62	62.97	10.25	3.15
1 86.30	2.58	.85	1.96	46.00	32.61	2.70	15.00	41.38	15.24	2.70	3.20	35.08	25.12	62.29	9.17	3.42
2 84.60	3.92	.96	2.05	46.00	37.61	2.80	10.00	41.93	16.33	2.04	2.13	35.24	18.03	65.52	14.38	2.07

	LSF	SH	AH	NH	CGS	CS	GA	CAF	CaO	SiO ₂	H ₂ O _s	Fe ₂ O ₃	LOI	Hard	LS	Sand	Iron ore
3	85.34	3.56	.93	2.03	46.00	36.59	2.80	11.00	41.82	16.11	2.18	2.34	35.21	19.51	64.85	13.30	27.33
4	85.64	3.00	.89	2.01	46.00	35.57	2.80	12.00	41.71	15.88	2.32	2.56	35.18	21.00	64.18	12.22	27.60
6	86.03	2.77	.87	1.99	46.00	34.55	2.80	13.00	41.60	15.66	2.45	2.77	35.15	22.49	63.51	11.14	27.87
7	86.34	2.57	.85	1.96	46.00	33.52	2.80	14.00	41.49	15.44	2.59	2.98	35.12	23.98	62.83	10.05	37.13
8	84.74	3.89	.97	2.05	46.00	32.50	2.90	15.00	41.37	15.21	2.73	3.20	35.09	25.47	62.16	8.97	37.40
9	85.07	3.54	.94	2.03	46.00	36.48	2.90	10.00	41.93	16.31	2.07	2.13	35.24	18.39	65.39	14.18	27.05
10	85.44	3.24	.92	2.01	46.00	35.46	2.90	11.00	41.81	16.08	2.20	2.34	35.21	19.87	64.72	13.10	27.32
11	85.74	2.98	.89	1.99	46.00	34.44	2.90	12.00	41.70	15.86	2.34	2.56	35.18	21.36	64.04	12.02	27.58
12	86.09	2.75	.88	1.99	46.00	33.42	2.90	13.00	41.59	15.64	2.48	2.77	35.15	22.85	63.37	10.93	27.85
13	86.44	2.55	.86	1.96	46.00	32.40	2.90	14.00	41.48	15.41	2.62	2.98	35.12	24.34	62.70	9.85	37.12
14	84.79	3.86	.98	2.04	46.00	32.39	2.90	15.00	41.37	15.19	2.75	3.20	35.09	25.83	62.02	8.76	37.38
15	85.19	3.51	.95	2.03	46.00	30.37	3.00	10.00	41.92	16.28	2.09	2.30	35.25	18.74	65.25	13.98	27.03
16	85.44	3.22	.93	2.01	46.00	35.35	3.00	12.00	41.70	15.83	2.37	2.56	35.18	20.23	64.58	12.90	27.30
17	85.80	2.96	.90	1.99	46.00	34.33	3.00	13.00	41.58	15.61	2.50	2.77	35.15	21.72	63.91	11.81	27.56
18	86.15	2.74	.88	1.99	46.00	33.31	3.00	14.00	41.47	15.39	2.64	2.98	35.12	23.21	63.23	10.73	27.83
19	86.50	2.54	.87	1.96	46.00	32.29	3.00	15.00	41.36	15.16	2.78	3.20	35.09	24.70	62.56	9.65	37.10
20	84.80	3.83	.99	2.04	46.00	32.29	3.10	10.00	41.91	16.26	2.12	2.13	35.25	19.10	65.12	13.77	27.01
21	85.14	3.49	.96	2.03	46.00	36.27	3.10	11.00	41.80	16.03	2.25	2.34	35.22	20.59	64.44	12.69	27.28
22	85.59	3.20	.94	2.01	46.00	35.24	3.10	12.00	41.69	15.81	2.39	2.56	35.19	22.07	63.77	11.61	27.54
23	85.86	2.94	.91	1.99	46.00	34.22	3.10	13.00	41.58	15.59	2.53	2.77	35.16	23.56	63.10	10.53	27.81
24	86.21	2.72	.89	1.97	46.00	33.20	3.10	14.00	41.47	15.36	2.66	2.98	35.12	25.06	62.42	9.44	37.08
25	86.54	2.52	.88	1.96	46.00	32.18	3.10	15.00	41.35	15.14	2.80	3.20	35.09	26.55	61.75	8.36	37.34
26	84.91	3.80	.98	2.04	46.00	32.18	3.20	10.00	41.91	16.23	2.14	2.13	35.25	19.46	64.98	13.57	27.99
27	85.24	3.47	.94	2.03	46.00	36.16	3.20	11.00	41.79	16.01	2.28	2.34	35.22	20.94	64.31	12.49	27.26
28	85.58	3.18	.91	2.01	46.00	35.14	3.20	12.00	41.68	15.79	2.41	2.56	35.19	22.43	63.64	11.41	27.52
29	85.92	2.92	.89	1.99	46.00	34.12	3.20	13.00	41.57	15.56	2.55	2.77	35.16	23.92	62.96	10.32	27.79
30	86.27	2.70	.88	1.97	46.00	33.10	3.20	14.00	41.46	15.34	2.69	2.98	35.13	25.41	62.29	9.24	37.06
31	86.62	2.51	.86	1.96	46.00	32.08	3.20	15.00	41.35	15.12	2.83	3.20	35.10	26.91	61.61	8.16	37.32
32	84.94	3.78	.98	2.04	46.00	32.07	3.30	10.00	41.90	16.21	2.16	2.13	35.25	19.81	64.84	13.37	27.97
33	85.34	3.44	.98	2.03	46.00	36.05	3.30	11.00	41.79	15.98	2.30	2.34	35.22	21.30	64.17	12.29	27.24

LSF	SH	AM	HM	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	Harl	LS	Sand	Iron Ore
185.6	3.16	.95	2.01	46.00	35.03	3.30	12.00	41.68	15.76	2.44	2.56	35.19	22.79	63.50	11.21	2.51
85.9	2.91	.93	1.99	46.00	34.01	3.30	13.00	41.57	15.54	2.58	2.77	35.16	24.28	62.83	10.12	2.77
86.3	2.69	.91	1.97	46.00	32.99	3.30	14.00	41.45	15.31	2.71	2.98	35.13	25.77	62.15	9.04	3.04
86.6	2.49	.89	1.96	46.00	31.97	3.30	15.00	41.34	15.09	2.85	3.20	35.10	27.26	61.48	7.95	3.31
85.0		1.03	2.04	46.00	36.96	3.40	10.00	41.89	16.18	2.19	2.13	35.26	20.17	64.71	13.17	1.95
85.36		.99	2.03	46.00	35.94	3.40	11.00	41.76	15.96	2.33	2.34	35.22	21.66	64.04	12.08	2.22
85.6		.96	2.01	46.00	34.92	3.40	12.00	41.67	15.74	2.46	2.56	35.19	23.15	63.36	11.00	2.49
86.0		.94	1.99	46.00	33.90	3.40	13.00	41.56	15.51	2.60	2.77	35.16	24.64	62.69	9.92	2.75
86.39		.92	1.97	46.00	32.88	3.40	14.00	41.45	15.29	2.74	2.98	35.13	26.13	62.02	8.84	3.02
86.74		.90	1.96	46.00	31.86	3.40	15.00	41.34	15.07	2.87	3.20	35.10	27.62	61.34	7.75	3.29
85.0	3.72	1.04	2.04	46.00	36.86	3.50	10.00	41.89	16.16	2.21	2.13	35.26	20.53	64.57	12.96	1.93
85.41	3.40	1.00	2.03	46.00	35.84	3.50	11.00	41.78	15.93	2.35	2.34	35.23	22.02	63.90	11.88	2.20
85.75	3.12	.97	2.01	46.00	34.82	3.50	12.00	41.66	15.71	2.49	2.56	35.20	23.50	63.23	10.80	2.47
86.1	2.87	.95	1.99	46.00	33.80	3.50	13.00	41.55	15.49	2.62	2.77	35.17	24.99	62.56	9.72	2.73
86.4	2.66	.93	1.97	46.00	32.78	3.50	14.00	41.44	15.26	2.76	2.98	35.13	26.49	61.88	8.63	3.00
86.8	2.47	.91	1.96	46.00	31.76	3.50	15.00	41.33	15.04	2.90	3.20	35.10	27.98	61.21	7.55	3.27

960

Annex III

COMPUTERIZED RAW MIXES: GROUP C
(Percentage)

Selected values

Raw materials used

	From	To	% increase per step
LSF	90.0	96.0	1.00
AM	1.50	3.50	.10

Chemical analysis

CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI
51.86	2.23	.58	.35	42.90
8.86	77.11	2.75	1.02	8.15
1.12	6.12	10.38	62.50	9.24

Designation

Limestone	(X ₁)
Sand	(X ₂)
Iron ore	(X ₃)

Source

Hawari quarry
Giulo area
Galmoya area

	LSF	SM	AM	HM	C3S	C2S	C3A	C4AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	X1	X2	X3
Raw mix no. 1	90.00	9.69	1.50	2.37	66.34	24.63	2.45	3.27	43.42	16.64	1.03	.69	36.11	80.44	19.22	.33
2	90.00	10.02	1.60	2.37	66.40	24.70	2.55	3.05	43.45	16.66	1.02	.64	36.12	80.48	19.26	.26
3	90.00	10.32	1.70	2.38	66.46	24.76	2.64	2.85	43.47	16.68	1.02	.60	36.13	80.52	19.29	.19
4	90.00	10.61	1.80	2.38	66.51	24.81	2.71	2.68	43.49	16.70	1.01	.56	36.14	80.55	19.32	.13
5	90.00	10.87	1.90	2.38	66.56	24.86	2.78	2.53	43.50	16.72	1.01	.53	36.15	80.58	19.34	.08
6	90.00	11.11	2.00	2.39	66.60	24.90	2.84	2.39	43.52	16.73	1.00	.50	36.16	80.60	19.36	.04
7	91.00	9.65	1.50	2.39	68.84	22.14	2.45	3.26	43.51	16.49	1.03	.68	36.18	80.65	19.02	.33
8	91.00	9.97	1.60	2.40	68.91	22.21	2.54	3.04	43.54	16.51	1.02	.64	36.19	80.69	19.06	.26
9	91.00	10.28	1.70	2.40	68.97	22.26	2.63	2.84	43.56	16.53	1.01	.60	36.20	80.72	19.09	.19
10	91.00	10.56	1.80	2.41	69.02	22.32	2.70	2.67	43.57	16.55	1.01	.56	36.21	80.76	19.11	.13
1	91.00	10.82	1.90	2.41	69.07	22.36	2.77	2.52	43.59	16.56	1.00	.53	36.22	80.78	19.14	.08
2	91.00	11.06	2.00	2.41	69.11	22.41	2.83	2.38	43.61	16.58	1.00	.50	36.23	80.81	19.16	.03
3	92.00	9.60	1.50	2.42	71.31	19.69	2.44	3.25	43.60	16.34	1.02	.68	36.25	80.85	18.82	.33
4	92.00	9.93	1.60	2.42	71.38	19.75	2.53	3.03	43.62	16.36	1.01	.63	36.26	80.89	18.86	.25
5	92.00	10.23	1.70	2.43	71.44	19.81	2.62	2.83	43.64	16.38	1.01	.59	36.27	80.93	18.89	.19
6	92.00	10.51	1.80	2.43	71.49	19.86	2.69	2.66	43.66	16.40	1.00	.56	36.28	80.96	18.91	.13
7	92.00	10.77	1.90	2.44	71.54	19.91	2.76	2.51	43.68	16.41	1.00	.53	36.29	80.99	18.94	.08
8	92.00	11.01	2.00	2.44	71.58	19.95	2.82	2.38	43.69	16.43	.99	.50	36.30	81.01	18.96	.03

Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
S102	6.19	6.21	6.23	6.25	6.27	6.28	6.05	6.07	6.09	6.11	6.12	6.13	5.91	5.93	5.95	5.96	5.98	5.99	5.77	5.79	5.81	5.82	5.84	5.85
H102	1.02	1.01	1.00	1.00	1.00	1.00	1.01	1.01	1.00	1.00	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fe2O3 LOT	68.36	63.36	59.36	55.36	52.36	50.36	67.36	63.36	59.36	55.36	52.36	49.36	67.36	63.36	59.36	55.36	52.36	49.36	67.36	62.36	58.36	55.36	52.36	49.36
LS	81.05	81.09	81.12	81.16	81.18	81.21	81.24	81.28	81.32	81.35	81.38	81.40	81.43	81.47	81.51	81.54	81.57	81.59	81.62	81.66	81.70	81.73	81.76	81.78
Sand	18.63	18.66	18.69	18.72	18.74	18.76	18.43	18.47	18.50	18.52	18.55	18.57	18.25	18.28	18.31	18.33	18.36	18.38	18.06	18.09	18.12	18.15	18.17	18.19
Iron Ore	33.33	33.25	33.19	33.13	33.08	33.03	32.32	32.25	32.18	32.13	32.08	32.03	32.32	32.25	32.18	32.12	32.07	32.03	32.32	32.24	32.18	32.12	32.07	32.03

Raw
mix
no.

LSF	4	93.00	9.56	1.50	2.94	73.74	17.28	2.43	3.24	43.68
	20	93.00	9.88	1.60	2.45	73.81	17.39	2.53	3.02	43.71
	1	93.00	10.18	1.70	2.45	73.87	17.40	2.61	2.82	43.73
	2	93.00	10.46	1.80	2.46	73.92	17.44	2.68	2.65	43.75
	3	93.00	10.72	1.90	2.46	73.97	17.49	2.75	2.50	43.76
	4	93.00	10.96	2.00	2.46	74.01	17.53	2.81	2.37	43.78
	5	94.00	9.52	1.50	2.47	76.13	14.90	2.42	3.23	43.77
	6	94.00	9.84	1.60	2.47	76.20	14.56	2.52	3.01	43.79
	7	94.00	10.14	1.70	2.48	76.26	15.02	2.60	2.81	43.81
	8	94.00	10.41	1.80	2.48	76.32	15.06	2.67	2.64	43.83
	9	94.00	10.67	1.90	2.49	76.37	15.11	2.74	2.49	43.85
	30	94.00	10.91	2.00	2.49	76.41	15.14	2.80	2.36	43.86
	1	95.00	9.47	1.50	2.49	78.48	12.55	2.41	3.22	43.85
	2	95.00	9.79	1.60	2.50	78.56	12.62	2.51	3.00	43.87
	3	95.00	10.09	1.70	2.50	78.62	12.67	2.59	2.80	43.90
	4	95.00	10.37	1.80	2.51	78.68	12.72	2.67	2.64	43.91
	5	95.00	10.62	1.90	2.51	78.73	12.76	2.73	2.49	43.93
	6	95.00	10.86	2.00	2.52	78.77	12.80	2.79	2.35	43.94
	7	96.00	9.43	1.50	2.52	80.80	10.26	2.41	3.21	43.93
	8	96.00	9.75	1.60	2.53	80.88	10.32	2.50	2.99	43.96
	9	96.00	10.04	1.70	2.53	80.94	10.37	2.58	2.80	43.98
	10	96.00	10.32	1.80	2.53	81.00	10.41	2.66	2.63	43.99
	1	96.00	10.57	1.90	2.54	81.05	10.45	2.72	2.48	44.01
	2	96.00	10.81	2.00	2.54	81.09	10.49	2.78	2.34	44.02

AH

HH

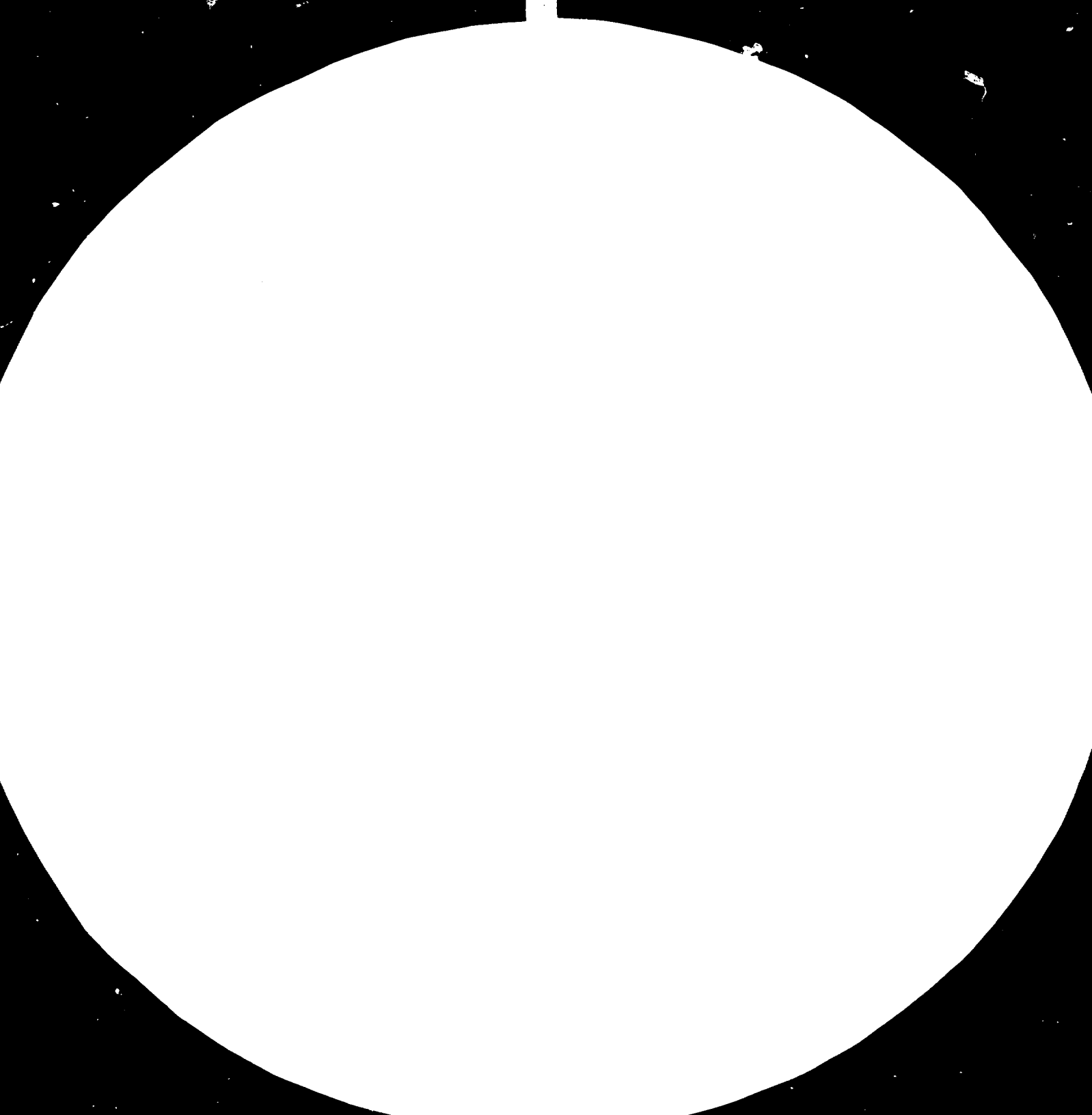
CS

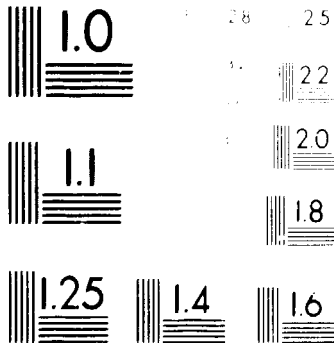
CAF

CAO

Annex IV
COMPUTERIZED RAW MIXES: GROUP D
(Percentage)

Selected values				Raw materials used												
	From	To	% increase per step	Chemical analysis					Designation	Source						
				CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI								
LSF	90.0	96.0	1.00	53.76	.04	.00	.20	43.95	Limestone	(X ₁)	Hawari quarry					
AM	1.50	3.50	.10	13.44	69.69	1.88	.40	12.20	Sand	(X ₂)	Gialo area					
				1.40	13.37	11.60	62.40	10.09	Iron ore	(X ₃)	Galmoya area					
Raw mix no.	LSF	SP	AM	FM	C3S	C2S	C3A	C4AF	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	LOI	X1	X2	X3
1	90.00	21.72	1.50	2.45	69.90	24.13	1.13	1.50	43.83	17.12	.47	.32	36.14	75.39	24.50	.11
2	90.00	22.46	1.60	2.45	69.93	24.16	1.17	1.40	43.84	17.13	.47	.29	36.14	75.41	24.52	.07
3	90.00	23.15	1.70	2.45	69.96	24.18	1.21	1.31	43.84	17.14	.47	.27	36.14	75.42	24.54	.04
4	90.00	23.80	1.80	2.45	69.98	24.21	1.24	1.23	43.85	17.15	.46	.26	36.15	75.43	24.56	.01
5	91.00	21.73	1.50	2.47	72.44	21.61	1.12	1.49	43.92	16.97	.47	.31	36.21	75.62	24.28	.10
6	91.00	22.43	1.60	2.48	72.47	21.64	1.16	1.39	43.93	16.98	.46	.29	36.21	75.63	24.30	.07
7	91.00	23.17	1.70	2.48	72.49	21.67	1.20	1.30	43.93	16.99	.46	.27	36.22	75.64	24.32	.04
8	91.00	23.81	1.80	2.48	72.52	21.69	1.23	1.22	43.94	16.99	.46	.25	36.22	75.65	24.34	.01
9	92.00	21.75	1.50	2.50	74.93	19.14	1.11	1.48	44.00	16.82	.46	.31	36.28	75.84	24.07	.10
10	92.00	22.50	1.60	2.50	74.96	19.17	1.15	1.37	44.01	16.83	.46	.29	36.28	75.85	24.09	.06
1	92.00	23.19	1.70	2.51	74.99	19.19	1.19	1.28	44.02	16.83	.46	.27	36.28	75.86	24.11	.03
2	92.00	23.83	1.80	2.51	75.01	19.22	1.22	1.21	44.03	16.84	.45	.25	36.29	75.87	24.12	.01
3	93.00	21.77	1.50	2.53	77.38	16.70	1.10	1.46	44.09	16.67	.46	.31	36.34	76.05	23.86	.09
4	93.00	22.52	1.60	2.53	77.42	16.73	1.14	1.36	44.10	16.68	.46	.28	36.35	76.06	23.88	.06
5	93.00	23.21	1.70	2.53	77.44	16.76	1.19	1.27	44.11	16.69	.45	.27	36.35	76.08	23.89	.03
6	93.00	23.85	1.80	2.54	77.47	16.78	1.21	1.20	44.12	16.69	.45	.25	36.36	76.09	23.91	.00
7	94.00	21.79	1.50	2.56	79.80	14.31	1.09	1.45	44.18	16.52	.46	.30	36.41	76.26	23.65	.09
8	94.00	22.54	1.60	2.56	79.83	14.33	1.13	1.35	44.19	16.53	.45	.28	36.42	76.28	23.67	.06
9	94.00	23.23	1.70	2.56	79.86	14.36	1.17	1.26	44.20	16.54	.45	.26	36.42	76.29	23.69	.03
10	94.00	23.87	1.80	2.56	79.89	14.38	1.20	1.17	44.20	16.55	.45	.25	36.42	76.30	23.70	.00
1	95.00	21.80	1.50	2.58	82.18	11.94	1.08	1.44	44.26	16.38	.45	.30	36.48	76.47	23.44	.09
2	95.00	22.55	1.60	2.59	82.22	11.97	1.12	1.34	44.27	16.39	.45	.28	36.48	76.48	23.46	.05
3	95.00	23.25	1.70	2.59	82.24	11.99	1.16	1.25	44.28	16.40	.44	.26	36.49	76.49	23.48	.02
4	96.00	21.82	1.50	2.61	84.53	9.62	1.07	1.43	44.35	16.24	.45	.30	36.54	76.67	23.24	.08
5	96.00	22.57	1.60	2.61	84.56	9.64	1.11	1.33	44.35	16.25	.44	.28	36.55	76.69	23.26	.05
6	96.00	23.27	1.70	2.62	84.59	9.66	1.15	1.24	44.36	16.26	.44	.26	36.55	76.70	23.28	.02





MICROSCOPE RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A
 NATIONAL BUREAU OF STANDARDS-1963-A
 NATIONAL BUREAU OF STANDARDS-1963-A
 NATIONAL BUREAU OF STANDARDS-1963-A

Annex V

REPORTS ISSUED UNDER THE PROJECT TF/LIB/75/002 OR TF/LIB/82/002

UNIDO/IOD.37 24 May 1976	Report on the first part (February to April 1976) of a year's mission by a building-materials adviser to the cement industry in Benghazi Aly Afify
UNIDO/IOD.174 11 July 1977	Report on the second part (November 1976 to August 1977) of a year's mission by a building-materials adviser to the cement industry in Benghazi Aly Afify
UNIDO/IOD.264 1 August 1978	Planning a system of mechanical maintenance Alfred Madsen
UNIDO/IOD.345 16 March 1979	Preventive maintenance planning in the mechanical maintenance service Mehmet A. Basman
UNIDO/IOD.354 15 August 1979	Assistance in instrument maintenance Boguslaw J. Walczenko
UNIDO/IOD.361 12 December 1979	Report of the project co-ordinator for the period up to October 1979 A.M. Afify
UNIDO/IOD.383 16 September 1980	Assistance to the electrical engineering staff in organizing and carrying out electrical maintenance Boguslaw J. Walczenko
UNIDO/IO.437 16 January 1981	Report on a one-month mission (from 11 November 1980) to review and evaluate the progress of the project A.M. Afify
UNIDO/IO.475 13 March 1981	Instrument maintenance systems at the Benghazi complex: final summary Boguslaw J. Walczenko
UNIDO/IO.472 6 July 1981	Report of a one-month mission (from 19 May 1981) to review and evaluate the progress of the project A.M. Afify
UNIDO/IO/R.7 30 July 1981	Raw materials deposits at Wadi Ash Shati and Al Jufrah Abd El R. Marei
UNIDO/IO/R.14 17 December 1981	Preliminary study for long-term technical advice A.M. Afify
UNIDO/IO/R.33 28 October 1981	Progress of the project from 10 May 1980 to 31 July 1981 A.R. Marei
UNIDO/IO/R.17 2 November 1981	Feasibility of producing sulphate-resisting cement A.R. Marei

- UNIDO/IO/R.29
26 March 1982
Replacing cvlpebs by grinding balls in Benghazi I and
Hawari cement mills
A.R. Marei
- UNIDO/IO/R.34
26 March 1982
Progress of the project from 1 August 1981 to
31 December 1981
A.R. Marei
- UNIDO/IO/R.42
26 March 1982
Formation of cement lumps and aggregation in cement
silos
A.R. Marei
- UNIDO/IO/R.53
26 March 1982
New gypsum deposits
A.R. Marei
- UNIDO/IO/R.84
4 January 1983
Progress of project from 1 January 1982 to 30 June
1982
A. R. Marei
- UNIDO/IO/R.85
24 January 1983
Feasibility study on plant for ready-mixed concrete
and prefabricated concrete products
A.R. Marei
- UNIDO/IO/R.99
27 October 1983
Evaluation of the raw material situation of the
Al Khums I Cement Plant
A.R. Marei
- UNIDO/IO/R.120
27 October 1983
Follow-up study on the introduction of
sulphate-resisting cement production
A.R. Marei

