PORTLAND CEMENT Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649468447

Portland Cement by A. C. Davis

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd. Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com



PORTLAND CEMENT

Trieste

PORTLAND CEMENT.

•

BY

.

A. C. DAVIS,

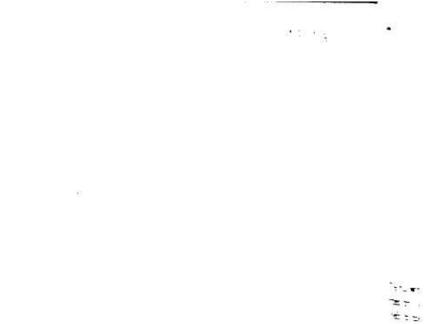
FELLOW OF THE CHEMICAL SOCIETY, MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY, ETC., ETC.

LONDON

125

OFFICES OF THE STONE TRADES JOURNAL: 36, 37, 38, SOUTHAMPTON STREET, W.C.

1904.







 \mathbf{t}_{1}

94337

6224274

.

5MG 1122

10

EDITORIAL.

The following articles upon Portland Cement were specially written by Mr. Davis, a well-known cement maker, for the benefit of the readers of *The Stone Trades Journal*, in which publication they originally appeared.

In response to numerous requests we have decided to re-issue in a more permanent form the information relating to the manufacture, chemistry and testing of cement which those articles contained.

The author has taken pains to make the science of cement an easy object for study by the general consumer, and the valuable illustrations which further explain the text, will, we think, justify our giving the work a more permanent form than was originally intended.

THE EDITOR.

. .

"THE STONE TRADES JOUENAL" OFFICES, 36, 37, 38, SOUTHAMPTON STREET, LONDON, W.C.

(*

.*

**

CONTENTS.

 \mathbb{R}^{n}

					Р	AGE.
Introduction,	35	12	10	1.1	••	I
Portland Cement-Chapter	1.		• •	(7 2	220	3
Raw Materials-Chapter II				1343		11
.Mixing-Chapter III.	**		**:		\mathbf{x}	18
Estimation of Raw Material	s—Cha	apter I	v.	••	••	27
[*] Calcining—Chapter V.	392) 1946)		••		22	34
Clinker Grinding-Chapter	VI.		• •		••	42
Chemistry of Cement-Chap	ter VI	1.	353		a20	49
Test for Weight and Specific	Gravi	ty—Ch	apter V	VIII.		57
Fineness-Chapter IX.	333	••	4.40		••	64
Setting-Chapter X.	**	••	• • •	**	∞	75
Tensile Strength-Chapter 1	KI.	••			••	87
Compression Tests—Chapter	XII.				-	99
Soundness and Variation of	Volum	e—Cha	pter >	(11 1.		103
Specifications-Chapter XIV	τ.	••	550			115



82

...

ŝ

а.

LIST OF ILLUSTRATIONS.

D. O. D.

Reservoir Wall in Cement Concrete. 2 Concrete Wall and Footpath. 5 Microscopic Sections of Chalk and Limestone 14 Raw Material Quarry at Cambridge. 13 Chalk Quarry on the Medway 15 Quarry in Lower Lias Formation 16 Wash Mill Employed in the Wet Process 18 Grit Mill for Wet Grinding 19 Drying Drum 20 Tower for Drying Raw Materials 21 Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 30						P	AGE.
Concrete Wall and Footpath. 9 Microscopic Sections of Chalk and Limestone 14 Raw Material Quarry at Cambridge. 13 Chalk Quarry on the Medway 13 Quarry in Lower Lias Formation 16 Wash Mill Employed in the Wet Process 18 Grit Mill for Wet Grinding 19 Drying Drum 20 Tower for Drying Raw Materials 21 Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 23 Faija's Dietrich Calcimeter 23 Scheibler's Calcimeter 30 Scheibler's Calcimeter 30 Dome or Bottle Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England. 39 Interior of Rotary Kiln Plant 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 58 Hopper and Bushel Measure 53	View of Modern Dry Proces	s Wo	rks in E	nglan	d	+	5
Microscopic Sections of Chalk and Limestone 11 Raw Material Quarry at Cambridge. 13 Chalk Quarry on the Medway 15 Quarry in Lower Lias Formation 16 Wash Mill Employed in the Wet Process 18 Grit Mill for Wet Grinding 19 Drying Drum 20 Tower for Drying Raw Materials 20 Tower for Drying Raw Materials 23 Raw Material Blocks Prepared for Burning 24 Dome or Bottle Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Battery of Griffin Mills 34 Laboratory Wash Bottle	Reservoir Wall in Cement (Concr	ete				7
Microscopic Sections of Chalk and Limestone 11 Raw Material Quarry at Cambridge. 13 Chalk Quarry on the Medway 15 Quarry in Lower Lias Formation 16 Wash Mill Employed in the Wet Process 18 Grit Mill for Wet Grinding 19 Drying Drum 20 Tower for Drying Raw Materials 20 Tower for Drying Raw Materials 23 Raw Material Blocks Prepared for Burning 24 Dome or Bottle Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Battery of Griffin Mills 34 Laboratory Wash Bottle	Concrete Wall and Footpat	h					9
Chalk Quarry on the Medway 15 Quarry in Lower Lias Formation 16 Wash Mill Employed in the Wet Process 18 Grit Mill Employed in the Wet Process 19 Drying Drum 20 Tower for Drying Raw Materials 21 Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 23 Faija's Dietrich Calcimeter 23 Dome or Bottle Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Flant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Drying, Ignition and Fusing 53 Drying, Ignition and Fusing 53 Hopper and Bushel Measure 59 Mann's Gravimeter 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Graving the Enstene flow Caments 63 <	Microscopic Sections of Cha	lk an	d Limes	tone	12220	200 C	11
Quarry in Lower Lias Formation 16 Wash Mill Employed in the Wet Process 18 Grit Mill for Wet Grinding 19 Drying Drum 20 Tower for Drying Raw Materials 21 Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 23 Faija's Dietrich Calcimeter 23 Scheibler's Calcimeter 30 Scheibler's Calcimeter 30 Scheibler's Calcimeter 30 Dome or Bottle Kiln 31 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Chemical Balance 53 Chemical Balance 58 Hopper and Bushel Measure 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Photo Plates of Flour and Residue <td>Raw Material Quarry at Ca</td> <td>mbrid</td> <td>lge</td> <td></td> <td></td> <td></td> <td>13</td>	Raw Material Quarry at Ca	mbrid	lge				13
Quarry in Lower Lias Formation 16 Wash Mill Employed in the Wet Process 18 Grit Mill for Wet Grinding 19 Drying Drum 20 Tower for Drying Raw Materials 21 Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 23 Faija's Dietrich Calcimeter 23 Scheibler's Calcimeter 30 Scheibler's Calcimeter 30 Scheibler's Calcimeter 30 Dome or Bottle Kiln 31 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Chemical Balance 53 Chemical Balance 58 Hopper and Bushel Measure 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Photo Plates of Flour and Residue <td>Chalk Quarry on the Medw</td> <td>ay</td> <td></td> <td></td> <td></td> <td></td> <td>15</td>	Chalk Quarry on the Medw	ay					15
Grit Mill for Wet Grinding 19 Drying Drum 20 Tower for Drying Raw Materials 20 Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 26 Michaeli's Calcimeter 26 Dome or Bottle Kiln 32 Dome or Bottle Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Drying, Ignition and Fusing 53 Chemical Balance 59 Mann's Gravimeter 59 Mann's Gravimeter 59 Mann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 63 Photo Plates of Flour and Residue 67 Photo Plates of Flour and Residue 7	Quarry in Lower Lias Form	ation	100.000	40400		40.9	16
Drying Drum 20 Tower for Drying Raw Materials 21 Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 30 Scheibler's Calcimeter 32 Dome or Bottle Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Drying, Ignition and Fusing 53 Drying Gravimeter 59 Mann's Gravimeter 52 Mann's Specific Gravity Bottle 52 Photo Plates of Flour and Residue 53 Chemical Soluti's Volumenometer 53 Schumann's Specific Gravity Bottle 53 <td>Wash Mill Employed in the</td> <td>Wet</td> <td>Process</td> <td></td> <td></td> <td></td> <td>18</td>	Wash Mill Employed in the	Wet	Process				18
Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 30 Scheibler's Calcimeter 32 Dome or Bottle Kiln 32 Dome or Bottle Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Gravimeter 52 Keate's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 63 Photo Plates of Flour and Residue 74 Godman's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 73 Gilmore Needles 76 Yo						÷.	19
Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 30 Scheibler's Calcimeter 32 Dome or Bottle Kiln 32 Dome or Bottle Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Gravimeter 52 Keate's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 63 Photo Plates of Flour and Residue 74 Godman's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 73 Gilmore Needles 76 Yo	Drying Drum						20
Mixing Machine Used in the Dry Process 22 Compound Wash Mills 23 Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 30 Scheibler's Calcimeter 32 Dome or Bottle Kiln 32 Dome or Bottle Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Gravimeter 52 Keate's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 63 Photo Plates of Flour and Residue 74 Godman's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 73 Gilmore Needles 76 Yo	Tower for Drying Raw Mat	erials	6 4 9				21
Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 32 Dome or Bottle Kiln 32 Dietzsch Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 42 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Drying, Ignition and Fusing 53 Chemical Balance 53 Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test 58 Hopper and Bushel Measure 59 Mann's Gravimeter 62 Griffin's Specific Gravity Bottle 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 63 Photo Plates of Flour and Residue 71 The Flouronneter 73 Gilmore Needles 77 Goodman's Cement Setter 77 Goodman's Cement Setter </td <td>Mixing Machine Used in the</td> <td>Dry</td> <td>Process</td> <td></td> <td></td> <td></td> <td>22</td>	Mixing Machine Used in the	Dry	Process				22
Raw Material Blocks Prepared for Burning 25 Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 32 Dome or Bottle Kiln 32 Dietzsch Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 42 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Drying, Ignition and Fusing 53 Chemical Balance 53 Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test 58 Hopper and Bushel Measure 59 Mann's Gravimeter 62 Griffin's Specific Gravity Bottle 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 63 Photo Plates of Flour and Residue 71 The Flouronneter 73 Gilmore Needles 77 Goodman's Cement Setter 77 Goodman's Cement Setter </td <td>Compound Wash Mills</td> <td></td> <td></td> <td>1</td> <td>÷.</td> <td></td> <td>23</td>	Compound Wash Mills			1	÷.		23
Faija's Dietrich Calcimeter 28 Michaeli's Calcimeter 30 Scheibler's Calcimeter 32 Dome or Bottle Kiln 32 Dome or Bottle Kiln 32 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Gravimeter 52 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 63 Photo Plates of Flour and Residue 74 Gilmore Needles 77 Godman's	Raw Material Blocks Prepar	red fo	r Burnin	ng			25
Michaeli's Calcimeter 30 Scheibler's Calcimeter 32 Dome or Bottle Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England. 39 Interior of Rotary Kiln Used in England. 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Drying, Ignition and Fusing 53 Chemical Balance 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 63 Choto Plates of Flour and Residue 63 Photo Plates of Flour and Residue 71 The Flouroneter 73 Gilmore Needles 77 Yotat Needles 77 Godman's Cement Setter 78	Faija's Dietrich Calcimeter			· · ·			28
Dome or Bottle Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England. 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing 53 Drying, Ignition and Fusing 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Gravimeter 62 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schuman's Specific Gravity Bottle 63 Schuman's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 74 The Flouronneter 73 Gilmore Needles 76 Vicat Needles 77 The Flouronneter 78	Michaeli's Calcimeter				1220		30
Dome or Bottle Kiln 34 Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England. 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing 53 Drying, Ignition and Fusing 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Gravimeter 62 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schuman's Specific Gravity Bottle 63 Schuman's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 74 The Flouronneter 73 Gilmore Needles 76 Vicat Needles 77 The Flouronneter 78	Scheibler's Calcimeter						32
Dietzsch Kiln 37 Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England. 39 Interior of Rotary Kiln Plant 47 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Drying, Ignition and Fusing 53 Chemical Balance 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 63 Choto Plates of Flour and Residue 63 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 67 Pats of Finely Ground Cements 71 Gilmore Needles 77 Yicat Needles 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 </td <td>Dome or Bottle Kiln</td> <td></td> <td></td> <td>1.1</td> <td></td> <td></td> <td>1.00</td>	Dome or Bottle Kiln			1.1			1.00
Diagram Shewing Interior Working of the Rotary Kiln 38 First Rotary Kiln Used in England. 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Chemical Balance 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test. 58 Hopper for Weight per Bushel Test. 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 63 Schumann's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue . 67 Pats of Finely Ground Cements 67 Ordimore Needles 77 Goidman's Cement Setter 77 Goidman's Cement Setter 77 Goidman's Cement Setting Recorder 83 Amsler-Laffon Apparatus for Testing Consistency. 83 Amsler-Laffon Apparatus for Testing Consistency. <	Dietzsch Kiln	100	1000			1.2	
First Rotary Kiln Used in England. 39 Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing. 53 Chemical Balance 53 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 59 Mann's Gravimeter 62 Keate's Specific Gravity Bottle 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Flask 63 Schumann's Ground Cements 66 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 71 The Flouroneter 73 Gilmore Needles 77 Yicat Needles 77 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 89 Briquette Mould 89 Amsler-Laffon Apparatus for Testing Consistency 89 <tr< td=""><td>Diagram Shewing Interior V</td><td>Vorki</td><td>ng of the</td><td>e Rota</td><td>rv Kili</td><td>a</td><td></td></tr<>	Diagram Shewing Interior V	Vorki	ng of the	e Rota	rv Kili	a	
Interior of Rotary Kiln Plant 41 Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Filtration 53 Drying, Ignition and Fusing 53 Chemical Balance 53 Chemical Balance 53 Hopper and Bushel Measure 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Floura dements 69 Cement Testing Sieves 71 The Flouroneter 73 Gilmore Needles 76 Vicat Needles 77 Mansler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 89 Briquette Mould 89 Arnold Press 90 <td>First Rotary Kiln Used in I</td> <td>Engla</td> <td>nd.</td> <td></td> <td></td> <td></td> <td></td>	First Rotary Kiln Used in I	Engla	nd.				
Battery of Griffin Mills 47 Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 53 Filtration 53 Drying, Ignition and Fusing 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 53 Hopper and Bushel Measure 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Floura and Residue 67 Pats of Finely Ground Cements 67 Yicat Needles 73 Gilmore Needles 76 Vicat Needles 77 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 90 </td <td>Interior of Rotary Kiln Pla</td> <td>nt</td> <td></td> <td></td> <td></td> <td></td> <td></td>	Interior of Rotary Kiln Pla	nt					
Kominor Mill for Cement Grinding 48 Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing 53 Chemical Balance 53 Laboratory Apparatus for Evaporation 54 Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Griffin's Specific Gravity Flask 63 Schuman's Specific Gravity Bottle 63 Schurann's Specific Gravity Bottle 63 Schurann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Coarse and Fine Cements 67 Pats of Finely Ground Cements 71 The Flouronneter 73 Gilmore Needles 77 Gordman's Cement Setter 77 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 90 <td>Battery of Griffin Mills</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>612.00</td>	Battery of Griffin Mills						612.00
Laboratory Wash Bottle 52 Filtration 53 Drying, Ignition and Fusing. 53 Chemical Balance 54 Laboratory Apparatus for Evaporation 55 Hopper and Bushel Measure 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Floura and Residue 67 Pats of Finely Ground Cements 69 Cement Testing Sieves 71 The Flouroneter 73 Gilmore Needles 77 Yicat Needles 77 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 90	Kominor Mill for Cement G	rindin	19				
Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test. 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 67 Gilmore Needles 73 Gilmore Needles 77 Yicat Needles 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 90	Laboratory Wash Bottle		· · · ·	100			
Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test. 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 67 Gilmore Needles 73 Gilmore Needles 77 Yicat Needles 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 90	Filtration	0.00	10 B	100			
Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test. 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 67 Gilmore Needles 73 Gilmore Needles 77 Yicat Needles 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 90	Drving, Ignition and Fusin	P					
Laboratory Apparatus for Evaporation 55 Hopper for Weight per Bushel Test. 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 67 Gilmore Needles 73 Gilmore Needles 77 Yicat Needles 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 90	Chemical Balance	•	3725				
Hopper for Weight per Bushel Test. 58 Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Coarse and Fine Cements 67 Pats of Finely Ground Cements 74 Gilmore Needles 77 Godman's Cement Setter 77 Goodman's Cement Setting Recorder 83 Amsler-Laffon Apparatus for Testing Consistency. 83 Arnold Press 89 Briquette Mould 89 Arnold Press 90	Laboratory Apparatus for J	Tyapo	ration	2.2			
Hopper and Bushel Measure 59 Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 69 Cement Testing Sieves 71 The Flouronneter 73 Gilmore Needles 76 Vicat Needles 77 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 91	Hopper for Weight per Busl	hel Te	st				
Mann's Gravimeter 61 Keate's Specific Gravity Bottle 62 Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Flask 63 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 67 Pats of Finely Ground Cements 67 Cement Testing Sieves 71 The Flouroneter 73 Gilmore Needles 76 Vicat Needles 77 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Apparatus for Testing Consistency 83 Arnold Press 90 Böhmé Hammer 91	Hopper and Bushel Measure		20 ((()) ⁽		261		
Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Coarse and Fine Cements 67 Pats of Finely Ground Cements 67 Cement Testing Sieves 71 The Flouronneter 73 Gilmore Needles 77 Goodman's Cement Setter 78 Amsler-Laffon Apparatus for Testing Consistency. 83 Amsler-Laffon Apparatus for Testing Consistency. 83 Arnold Press 90 Böhmé Hammer 91	Mann's Gravimeter	1X -	- 25		- 22		
Blount's Volumenometer 62 Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Coarse and Fine Cements 67 Pats of Finely Ground Cements 67 Cement Testing Sieves 71 The Flouroneter 73 Gilmore Needles 77 Goodman's Cement Setter 78 Amsler-Laffon Apparatus for Testing Consistency. 83 Amsler-Laffon Apparatus for Testing Consistency. 83 Arnold Press 90 Böhmé Hammer 91	Keate's Specific Gravity Bo	ttle	200				222 0
Griffin's Specific Gravity Flask 63 Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Flour and Residue 65 Pats of Finely Ground Cements 67 Cement Testing Sieves 71 The Flouroneter 73 Gilmore Needles 76 Vicat Needles 77 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Cement Setting 89 Arnold Press 90 Böhmé Hammer 91	Blount's Volumenometer		0.55	1. T. T.			
Schumann's Specific Gravity Bottle 63 Photo Plates of Flour and Residue 65 Photo Plates of Coarse and Fine Cements 67 Pats of Finely Ground Cements 69 Cement Testing Sieves 71 The Flourometer 73 Gilmore Needles 77 Yotat Needles 77 Godman's Cement Setter 78 Amsler-Laffon Apparatus for Testing Consistency. 83 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 91	Griffin's Specific Gravity Fla	isk	24.04				12.7
Photo Plates of Flour and Residue 65 Photo Plates of Coarse and Fine Cements 67 Pats of Finely Ground Cements 67 Ocement Testing Sieves 71 The Flouronneter 73 Gilmore Needles 76 Vicat Needles 77 Goodman's Cement Setter 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Cement Setting Recorder 89 Arnold Press 90 Böhmé Hammer 91	Schumann's Specific Gravit	v Bo	ttle		1.53	10.22	
Photo Plates of Coarse and Fine Cements 67 Pats of Finely Ground Cements 69 Cement Testing Sieves 71 The Flourometer 73 Gilmore Needles 76 Vicat Needles 77 Goodman's Cement Setter 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Cement Setting Recorder 85 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 91	Photo Plates of Flour and F	lesidu	B	12.2	202		
Pats of Finely Ground Cements 69 Cement Testing Sieves 71 The Flourometer 73 Gilmore Needles 76 Vicat Needles 77 Goodman's Cement Setter 77 Amsler-Lafton Apparatus for Testing Consistency. 83 Amsler-Lafton Cement Setting Recorder 85 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 91	Photo Plates of Coarse and	Fine I	Cements				
Cement Testing Sieves	Pats of Finely Ground Ceme	nts	Comoneo				
The Flourometer 73 Gilmore Needles 76 Vicat Needles 77 Goodman's Cement Setter 78 Amsler-Laffon Apparatus for Testing Consistency 83 Amsler-Laffon Cement Setting Recorder 85 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 91	Cement Testing Sieves		0.55				
Vicat Needles	The Flourometer				•••		
Vicat Needles	Gilmore Needles						
Amsler-Laffon Apparatus for Testing Consistency. 83 Amsler-Laffon Cement Setting Recorder 85 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 91	Vicat Needles						
Amsler-Laffon Apparatus for Testing Consistency. 83 Amsler-Laffon Cement Setting Recorder 85 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 91	Goodman's Cement Setter		1.1				
Amsler-Laffon Cement Setting Recorder 85 Briquette Mould 89 Arnold Press 90 Böhmé Hammer 91	Ameler-Laffon Apparatus for	Test	ing Con	istene			
Briquette Mould	Ameler J affon Coment Satti	ng P	corder	Adjent		0.00	80
Böhmé Hammer 91	Briquette Mould	-6 10					80
Böhmé Hammer 91	Arnold Press						
Adie Testing Machine	Rahma Hammar						
Acte result Machine	Adia Tasting Mashing						
	Acte resung Machine		5 C	100	13	(19 1)	93