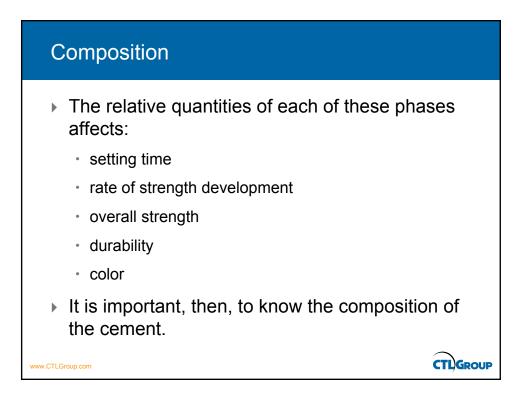
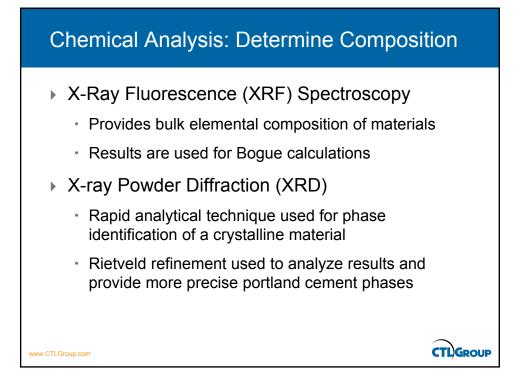


ASTM C150 Requirements					
Chemical Requirements	Physical Requirements				
Chemical analysis	Fineness				
Compound composition	Soundness				
Chemical limits	Consistency (Flow and Normal Consistency)				
	Setting Time				
	False set and flash set				
	Compressive strength				
	Heat of hydration				
	Loss on ignition				
	Density				
	Air content				
www.CTLGroup.com	Sulfate expansion				

Compositior	۱		
Chemical Name		Notation	Mass (%)
Tricalcium silicate	3CaO•SiO ₂	C₃S	50-70
Dicalcium silicate	2CaO• SiO ₂	C ₂ S	15-30
Tricalcium aluminate	3CaO•Al2O ₃	C ₃ A	5-10
Tetracalcium aluminoferrite	4CaO•Al ₂ O ₃ •Fe ₂ O ₃	C₄AF	5-15
Calcium sulfate dihydrate	CaSO ₄ .2H ₂ O	CSH ₂	~ 5
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Chemica	al Analysis	
Oxide		ASTM C 114 - Standard Test
SiO ₂	Silicon dioxide	Methods for Chemical Analysis
Al ₂ O ₃	Aluminum oxide	of Hydraulic Cement
Fe ₂ O ₃	Ferric oxide	
CaO	Calcium oxide	- Major Components
MgO	Magnesium oxide	
SO ₃	Sulfur trioxide	
LOI	Loss on ignition	
Na ₂ O	Sodium oxide	
K ₂ O	Potassium oxide	
TiO ₂	Titanium dioxide	
P ₂ O ₅	Phosphorus pentoxide	Minor Components
ZnO	Zinc oxide	
Mn_2O_3	Manganic oxide	
Sulfide sulfur		

Chem	ical Ana	lys	sis				
Oxide				<u>Oxide</u>	<u>Shorthand</u>	Common Name	
SiO ₂	20.6			CaO	С	Lime	
Al ₂ O ₃	5.07			SiO_2	S	Silica	
				00.05%	Al_2O_3	А	Alumina
Fe ₂ O ₃	2.90		<u> </u>	Fe_2O_3	F	Ferric Oxide	
CaO	63.9			MgO	М	Magnesia	
MgO	1.53			K ₂ O	К	Alkalis	
SO ₃	2.53			Na ₂ O	Na	Aikalis	
				SO_3	<u>S</u>	Sulfate	
Na ₂ O	0.15			CO_2	<u>C</u>	Carbonate	
K ₂ O	0.73			H ₂ O	<u>H</u>	Water	
LOI	1.58						

Compound Composition
 Bogue Composition/Calculations

Alite (Tricalcium Silicate) $C_3S = 4.07C - 7.60S - 6.72A - 1.43F - 2.85S$

Belite (Dicalcium Silicate) $C_2S = 2.87S - 0.75C_3S$

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Aluminate Phase (Tricalcium Aluminate) $C_3A = 2.65A - 1.69F$

Ferrite Compounds(Tetracalcium Aluminoferrite) C₄AF = 3.04F

Compound	Comp	osition [.]	Fxamp	le Boque
Compound				lo boguo

Oxide		Calculated Phase Composition	n	
SiO ₂	20.6	$C_3S = 4.07(63.9) - 7.60(20.6)$	– 6.72(5	.07)
Al ₂ O ₃	5.07	- 1.43(2.90) - 2.85(2.53	8) = 58.1	
Fe_2O_3	2.90	C ₂ S = 2.87(20.6) – 0.75(58.1)	= 15.6	
CaO	63.9			
MgO	1.53	C ₃ A = 2.65(5.07) – 1.69(2.90)	= 8.5	
SO3	2.53		Phase	%
Na ₂ O	0.15	C ₄ AF = 3.04(8.8) = 8.8	C ₃ S	58
K ₂ O	0.73		C ₂ S	16
LOI	1.58		C₃A C₄AF	9

Bogue Composition Assumptions

- All 4 phases are pure
- All the F present occurs as C₄AF, and the quantities of A = 0.64(% F) and C = 1.40 (% F) are subtracted from the appropriate totals.
- The remaining Al₂O₃ is combined as C₃A and a further quantity of C = 1.65 (% Al₂O₃) is subtracted from the total remaining CaO.
- ▶ The SiO₂ combines initially with CaO to form C₂S giving a provisional C₂S figure. The CaO combining with SiO₂ = 2.87%(SiO₂) is subtracted from the total CaO figure, and the remaining CaO is then combined with a part of the C₂S = 4.07(%CaO) to form C₃S.

As a result, Bogue compositions may be "off" by as much as 10% compared to XRD-determined compositions.

Compound Composition: Example Equivalent Alkalis

Oxide	%	Sodium equivalent, Na ₂ O _e
SiO ₂	20.6	Na ₂ O _e = Na ₂ O + (0.658 x K ₂ O)
AI_2O_3	5.07	
Fe_2O_3	2.90	Na ₂ O _e = 0.15 + (0.658 x 0.73)
CaO	63.9	
MgO	1.53	Na ₂ O _e = 0.63%
SO3	2.53	
Na ₂ O	0.15	
K ₂ O	0.73	
LOI	1.58	CTLGROUP

r	1				
		I	ement Typ		1
		Ш	- 111	IV	V
SiO ₂ , min. %	-	20.0	-	-	-
Al ₂ O ₃ , max. %	-	6.0	-	-	-
Fe ₂ O ₃ , max. %	-	6.0	-	6.5	-
MgO, max. %	6.0	6.0	6.0	6.0	6.0
SO ₃ , max. %					
C ₃ A ≤ 8%	3.0	3.0	3.5	2.3	3.0
C ₃ A > 8%	3.5	n/a	4.5	n/a	n/a
LOI, max. %	3.0	3.0	3.0	2.5	3.0
Insoluble residue, max. %	0.75	0.75	0.75	0.75	0.75

Bogue Limits	;					
		С	ement Typ	be		[
	I	П	Ш	IV	V	ĺ
C ₃ A, max. %	-	-	8	-	-	ĺ
C ₃ A, max. %	-	-	5	-	-	İ
C ₃ 3 + C ₃ A, max. %	-	58	-	-	-	ĺ
Na ₂ Oe, max. %	0.60	0.60	0.60	0.60	0.60	
						•
www.CTLGroup.com						JP

Physical Requirements for Portland Cement Types

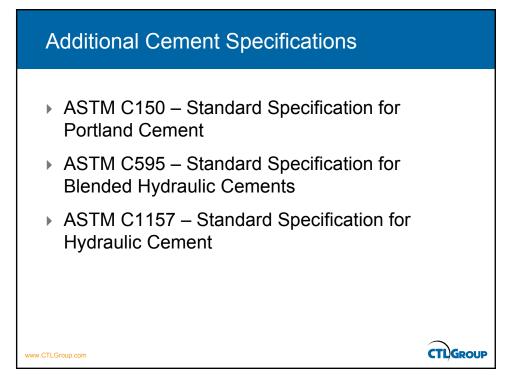
Compressive Strength

Minimum Strength Requirements, Mpa (psi)

Age	Cement Type					
	I	Ш	Ш	IV	v	
1 day	-	-	12.0	-	-	
			(1740)			
3 days	12.0	10.0	24.0	-	8.0	
	(1740)	(1450)	(3480)		(1160)	
7 days	19.0	17.0	-	7.0	15.0	
	(2760)	(2470)		(1020)	(2180)	
28 days	-	-	-	17.0	21.0	
				(2470)	(3050)	

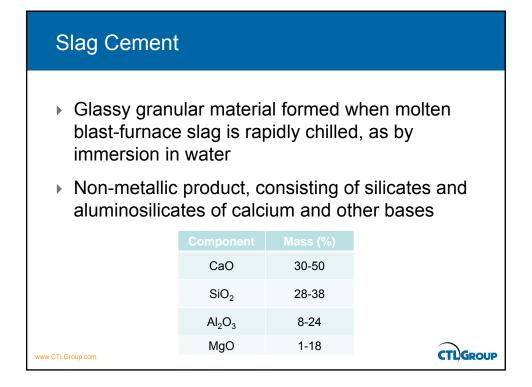
Physical	Requirements for Portland Cement
Types	

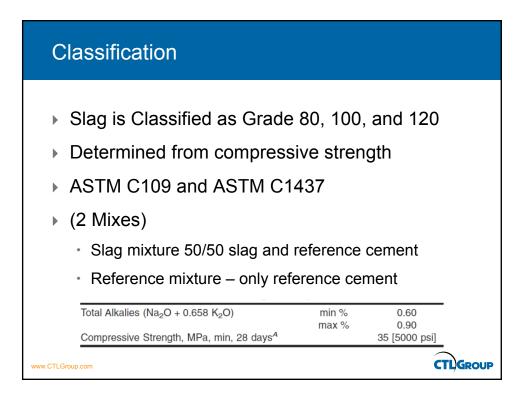
Cement Type	I	II	III	IV	V
Air content of mortar, volume %					
max	12	12	12	12	12
Air permeability test (blaine)					
Average value, min.	160	160		160	160
Any one sample, min.	150	150		150	150
Average value, max.		240		240	
Any one sample, max.		245		245	
Autoclave expansion, max. %	0.8	0.8	0.8	0.8	0.8
Time of setting; Vicat test:					
Time of Setting, min. (not less than)	45	45	45	45	45
Time of Setting, min. (not more thar	375	375	375	375	375
					TLGROUP











Classification							
Slag Activity Index, % = (SP / P) X 100							
 SP = Average compressive strength of slag-cement mortar cubes, MPa P = Average compressive strength of cement mortar cubes, MPa 							
	Average of Last Five Consecutive Samples	Any Individual Sample					
Slag Activity Index							
28-Day Index, min.%							
Grade 80	75	70					
Grade 100	95	90					
Grade 120	115	120					
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Physical Requirements	
	Item
Fineness:	
Amount retained when wet screened on a 45-μm Sieve, max. %	20
Specific surface by air permeability, Test Methods C204 shall be determined and reported although no limits are requried.	
Air Content of Slag Mortar, max. %	12
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