

# Typical Cement Notations and Parameters

## CEMENT CHEMISTS' NOTATIONS

A = Al <sub>2</sub> O <sub>3</sub>	K = K <sub>2</sub> O	S = SiO <sub>2</sub>
C = CaO	H = H <sub>2</sub> O	$\bar{S}$ = SO <sub>3</sub>
$\bar{C}$ = CO <sub>2</sub>	M = MgO	P = P <sub>2</sub> O <sub>5</sub>
F = Fe <sub>2</sub> O <sub>3</sub>	N = Na <sub>2</sub> O	T = TiO <sub>2</sub>

## CEMENT MANUFACTURING PARAMETERS

(Values are percentages by mass)

$$\text{Silica Ratio (SR)} = \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3}$$

$$\text{Alumina-Iron Ratio (A/F)} = \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3}$$

Lime Saturation Factor (LSF)

$$\text{If } A/F > 0.64 \quad \text{LSF} = \frac{\text{CaO}}{2.8 \text{ SiO}_2 + 1.65 \text{ Al}_2\text{O}_3 + 0.35 \text{ Fe}_2\text{O}_3}$$

$$\text{If } A/F < 0.64 \quad \text{LSF} = \frac{\text{CaO}}{2.8 \text{ SiO}_2 + 1.1 \text{ Al}_2\text{O}_3 + 0.7 \text{ Fe}_2\text{O}_3}$$

Percent Liquid (Liquid Phase) = 1.13 C<sub>3</sub>A + 1.35 C<sub>4</sub>AF + MgO\* + Alkalies  
(\*MgO should not exceed 2%)

$$\text{Burnability Index (BI)} = \frac{\text{C}_3\text{S}}{\text{C}_4\text{AF} + \text{C}_3\text{A}}$$

Burnability Factor (BF) = LSF + 10 SR - 3 (MgO + Alkalies)

Ignition Loss = 0.44 CaCO<sub>3</sub> + 0.524 MgCO<sub>3</sub>

(does not include clays' moisture of constitution)

Total Carbonates (TC) = 1.784 CaO + 2.09 MgO

Total Alkalies as Na<sub>2</sub>O = Na<sub>2</sub>O + 0.658 K<sub>2</sub>O

Percent Calcination (Raw Feed) =  $\frac{(f_i - d_i)}{f_i} \times 100$

(f<sub>i</sub> = Ignition loss of original feed; d<sub>i</sub> = ignition loss of the sample)

## BOGUE CALCULATION FOR CLINKER CONSTITUENTS

If  $A/F = > 0.64$

$$C_3S = 4.071 \text{ CaO} - (7.602 \text{ SiO}_2 + 6.718 \text{ Al}_2\text{O}_3 + 1.43 \text{ Fe}_2\text{O}_3)^*$$

$$C_2S = 2.867 \text{ SiO}_2 - 0.7544 C_3S$$

$$C_3A = 2.65 \text{ Al}_2\text{O}_3 - 1.692 \text{ Fe}_2\text{O}_3$$

$$C_4AF = 3.043 \text{ Fe}_2\text{O}_3$$

If  $A/F = < 0.64$

$$C_3S = 4.071 \text{ CaO} - (7.602 \text{ SiO}_2 + 4.479 \text{ Al}_2\text{O}_3 + 2.859 \text{ Fe}_2\text{O}_3)^*$$

$$C_2S = 2.867 \text{ SiO}_2 - 0.7544 C_3S$$

$$C_3A = 0$$

Solid Solution ( $C_4AF + C_2F$ ) =  $21.1 \text{ Al}_2\text{O}_3 + 1.702 \text{ Fe}_2\text{O}_3$

(\*For calculating  $C_3S$  in cement,  $2.852 \text{ SO}_3$  is added to the parentheses in the equation)

## CLINKER AND CEMENT CONSTITUENTS

Tricalcium Silicate	$C_3S$	$3\text{CaO} \cdot \text{SiO}_2$
Dicalcium Silicate	$C_2S$	$2\text{CaO} \cdot \text{SiO}_2$
Tricalcium Aluminate	$C_3A$	$3\text{CaO} \cdot \text{Al}_2\text{O}_3$
Tetracalcium Aluminoferrite	$C_4AF$	$4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$
Anhydrite	$C\bar{S}$	$\text{CaO} \cdot \text{SO}_3$
Gypsum	$C\bar{S}H$	$\text{CaO} \cdot \text{SO}_3 \cdot 2\text{H}_2\text{O}$
Hemihydrate (Bassanite)	$C\bar{S}H_{0.5}$	$\text{CaO} \cdot \text{SO}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$
Calcium Carbonate	$C\bar{C}$	$\text{CaO} \cdot \text{CO}_2$

## CEMENT HYDRATION PRODUCTS

Calcium Hydroxide	$CH$	$\text{CaO} \cdot \text{H}_2\text{O}$
Calcium Silicate Hydrate	$C-S-H$	$3\text{CaO} \cdot 2\text{SiO}_2 \cdot 8\text{H}_2\text{O}$
Ettringite or Trisulfoaluminate Hydrate	$C_6A\bar{S}_3H_{32}$	$6\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{SO}_3 \cdot 32\text{H}_2\text{O}$
Monosulfoaluminate Hydrate or Monosulfate	$C_4A\bar{S}H_{12}$	$4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{SO}_3 \cdot 12\text{H}_2\text{O}$
Water	$H$	$\text{H}_2\text{O}$