Mineral Binders I

Theoretical issues for self-study:
Classification of silicates and aluminosilicates into structural groups, examples of silicate and aluminosilicate structures, diadochia - concept, types and examples, classification of mineral binders, air binders: lime, gypsum, anhydrite, magnesia, hydraulic binders: hydraulic lime, cement.

Laboratory equipment: burette, Erlenmeyer flasks, beaker, and measuring cylinder.

Reagents: 0.5 M KOH, 0.5 M HCl, phenolphthalein.

Methodology:
Put 1.0 g of dried and thoroughly powdered cement into the Erlenmeyer flask (conical flask). Using a measuring cylinder, measure 80 cm^3 of distilled water, boil it in a beaker and pour it into the conical flask. Then add 40 cm^3 of 0.5 M HCl to it and boil its contents for 3 minutes to let out carbon dioxide. After boiling, add 3-5 drops of 1% phenolphthalein solution and titrate while still hot, with 0.5 M KOH solution until pink colour of the titrated solution appears. Note the amount of Volume (cm^3) of 0.5M KOH used in the titration. Repeat the experiment. Write down both the reactions occurring when hydrochloric acid solution is added to the cement and during the titration.

Calculations:
The free CaO content of the sample is calculated using the formula:
%CaO = (40 – A) · 0.014 ·100%

where:
A - amount (cm^3 of 0.5 M KOH used to neutralise the hydrochloric acid excess that has not reacted with the free CaO present in 1 g of cement;
(40 - A) – the amount of cm^3 of 0.5 M HCl that has reacted with the free CaO present in 1 g of cement;
0.014 – the amount of CaO, expressed in grams, reacting with 1 cm^3 of 0.5 M HCl.

Formulas for calculating modules:

$$\text{Hydraulic module} = \frac{\%CaO}{\%SiO_2 + \%Al_2O_3 + \%Fe_2O_3}$$

$$\text{Silicate module} = \frac{\%SiO}{\%Al_2O_3 + \%Fe_2O_3}$$

$$\text{Aluminium module} = \frac{\%Al_2O_3}{\%Fe_2O_3}$$

Percentage content: Al_2O_3 4,53% , Fe_2O_3 4,63%, SiO_2 22,12%.

Literature:

- ✓ R. M. E Diamant, The chemistry of building materials, Business Books, 1970
- ✓ R. J. Naumann, Introduction to the Chemistry and Physics of Building Materials, Taylor&Francis, 2008
- ✓ L.E. Czarnecki, P. Łukowski, A. Garbacz, B. G. Chmielewska, J. Kuziak, Building Chemistry. Laboratory Exercises, Oficyna Wydawnicza Politechniki Warszawskiej, 2016
- ✓ and other textbooks and scripts related to the subject of laboratory exercises.