AMERICAN JOURNALS
Open Access, Peer Reviewed Journals

American Journal of Pedagogical and Educational Research
ISSN (E): 2832-9791| Volume 13, | June, 2023

CHEMICAL COMPOSITION OF PORTLAND CEMENT CLINKER

Jovliyev Ziyodulla Anvar Ogli
(Termiz State University)
(tel.+998905228116, e-mail.: jovliyevziyodulla393@mail.ru)

A B S T R A C T

A summary of research on the composition of Portland cement clinker.

K E Y W O R D S

portland cement, clinker, mineralogical composition, alite, belite, tricalcium aluminate, alumoferrite

INTRODUCTION

In the production of Portland cement clinker, carbonate rocks containing a lot of calcium carbonate and clays containing silicon oxide, aluminum oxide and iron oxide, as well as natural mixtures of clay and calcium carbonate (marls) are used as raw materials. In recent years, in order not to use clay completely or partially, sour and basic blast furnace slag, as well as nepheline waste, are used in the production of portland cement. Also, a complex technology for obtaining portland cement and SO2 gas by mixing gypsum or anhydrite with clay has been developed. This technology has been introduced in countries where sulfuric acid production is low.

Nepheline sludge is produced as a waste product in the aluminum oxide industry. It contains 25...30% SiO^2, 2...5% Al^2O^3, 35% Fe^2O^3, 50...58% SaO and 3...8% other materials with 15...20% limestone. it is possible to prepare a mixture of raw materials for the production of shib and portland cement.

The use of nepheline slurry increases the efficiency of furnaces by 20...30% and reduces fuel consumption by 25%. Blast furnace slag containing up to 40...50% calcium oxide is also a valuable raw material for Portland cement production. Currently, they are not used in large quantities, but it is possible to organize large portland cement production enterprises based on them. Chemical composition: the quality of cement depends on the chemical composition of the raw material to be fired. Therefore, chemical analysis of clinker is a means of quality control. In this case, not only the most important oxides such as CaO, Al^2O^3, SiO^2, Fe^2O^3.Mg, but also MnO found in the composition of raw materials. The amount of secondary constituents such as Na^2O is also determined. Usually, the amount of these oxides in clinker is in the following limits:

The resulting amount of these is 95 97%.

Calcium oxide SaO is the main component of clinker. To obtain high-quality cement, SaO in it is not in the free state, but acidic oxides SiO^2. Al^2O^3 should be chemically bonded with Fe^2O^3. The amount of free SaO in the clinker should not exceed 1%, otherwise it will cause an uneven change in cement volume. During high-temperature burning, excess lime is burnt to a great extent. Due to this, its

fading occurs when the cement mass hardens, and not during solidification, when the mixture is soft. Due to the fact that the tensile strength of the mortar occurs in combination with the strong expansions in volume, these points generate stresses that cause cracks and failure of the concrete or mixture.

An increase in the amount of CaO (in its combination with acidic oxides) increases strength and accelerates the hardening process of cement, but decreases water resistance. Silica SiO^2 is one of the most important constituents of clinker, which, together with alumina Al^2O^3 and iron oxide Fe^2O^3, ensures the combination of calcium oxide CaO and the formation of compounds with hydraulic hardening properties in portland cement. With the increase of SiO^2 in cement, the retention process slows down, the speed of the hardening process is even slower in the first periods. In the following periods, when the consistency increases sufficiently, its resistance to water and sulfate waters also increases.

Clay Al^2O^3 - when there is a large amount, portland cement sets and hardens much faster in the initial periods, but the subsequent process of cement strength increase is slowed down, cements are resistant to water, sulfates and cold.

Fe^2O^3 in iron oxide reduces the temperature of clinker. Cements rich in iron oxide are slow setting, long-hardening, and sulfate-resistant, even when clay content is low, even when silica is low.

In magnesium oxide, the amount of MgO in clinker should not exceed 5%. Because, a large part of magnesium oxide is explained by being in a free state in the form of periclase. It burns at a high temperature, combines (hydrates) very slowly with water during the hardening of the mixture and concrete. The excess amount, in turn, causes an uneven change in the volume of the cement and thus leads to distortions.

Titanium (IV) oxide TiO^2 is always present in clay and occurs in clinker in an amount of no more than 0.3%. Its presence in small amounts is beneficial because it helps to better crystallization of clinker minerals.

Manganese oxide also contains MnO up to 1.5% in clinker and even more when blast furnace slag is used. Na^2O K^2O alkalis are present in clinker from 0.5% to 1% and K2O is more than Na^2O. The presence of alkalis is undesirable due to the fact that it is the cause of stabilization of the retention time of cement and the occurrence of nausea in cement products. SO^3 gold match anhydrite gypsum is required to control the retention time of the cement.

The main minerals of clinker are: alite, belite, tricalcium aluminate and aluminoferrite.

Alite 3CaO SiO^2 is the most important mineral that determines the setting speed, strength and other properties of clinker in portland cement and is present in clinker in the amount of 45-60%. It consists of tricalcium silicate and a solid mixture of small (2-4%) MgO, Al^2O^2, P^2O^5, Sr^2O^3 and other impurities that can greatly affect its structure and properties. Alite occurs in three polymorphic modifications. The strength and properties of cement are affected by the size, appearance, and degree of crystallization of alite crystals.

Belite 2CaO SiO^2 is the second silicate mineral in importance and quantity (1530%) of clinker. It hardens slowly, but when Portland cement hardens for a long time, great strength is achieved. There are four polymorphic modifications of belitin; a-C^2S, a'-C^3S, b- C^2S, g- C2S.

The transition of b- C^2S to g- C^2S occurs with an increase in absolute volume of about 10%, as a result, the particles of the substance are divided and turn into day g- C2S does not react with water at a temperature of 1000 C and has binding properties won't be. The hydraulic activity of belite depends on the structure of the crystals, for example, if the crystals are densely rounded, the cements have high

strength. b-C²S and a small (1-3%) amount of Al²O³ Fe²O³. MgO. is a solid mixture of Sr²O³. During the cooling of clinker below 5250 C, β-C²S, γ-C2S can transition, and the transition is accompanied by an increase in the basic distance, that is, a softening of the molecular structure of belite. Due to the fact that the density of β-C²S is greater than the density of g-C²S, the polymorphic transition leads to the expansion of the absolute volume of the belite by about 10%, and as a result, the clinker grains (granules) are dispersed as powder. Self-dispersion facilitates the crushing of clinker, but g-C²S powder practically does not react with water at a temperature of 1000 C, that is, it does not have binding properties. Because of this, it is necessary to prevent the transition of the belit to the g- form. Some impurities (1-3%) in the amount of Al²O³ for the recovery of β-C²S. Fe²O³. MgO. Sg²O3³ also helps in rapid cooling of clinker in chillers. In this case, a clinker containing dense crystals of rounded belite is obtained.

Approximate chemical and mineralogical composition of clinker

Kn	n_s	Mineral composition by weight %					
		$C_4A_3\bar{S}$	C_4AF	C_2S	$C_5S_2\bar{S}$	$C\bar{S}_{cb}$	C_3S
0,667	1,0	14,51	5,38	---	77,73	---	---
	1,5	13,10	4,84	---	69,29	10,06	---
	2,0	11,91	4,44	---	63,10	18,07	---
0,75	1,0	14,61	5,39	---	59,05	---	18,49
	1,5	13,48	4,99	---	54,43	7,71	17,21
	2,0	12,48	4,66	---	50,26	14,31	16,10
0,80	1,0	14,62	5,42	---	47,53	---	30,01
	1,5	13,79	5,20	---	48,32	5,37	25,11
	2,0	12,84	4,84	---	42,03	11,76	26,37

The amount of silicate minerals in Portland cement clinker is estimated to be 75-82%, while the remaining 18-25% are volume-filling intermediates between alite and belite crystals. These substances consist of crystals of tricalcium aluminate C³A and aluminoferrite calcium S⁴AF, glass and secondary crystals, etc. C³A - tricalcium aluminate - is present in clinker in the amount of 3-15%. Although it occurs in the form of S⁵A³, it forms solid mixtures with a complex composition of 12SaO 7Al²O³, but it does not have such great strength. It is the cause of sulfate corrosion of concrete.

REFERENCES

1. Maxmudova N.A. Bog‘ lovchi moddalar T., TAQI, o'quv qo'llanma 2012. - 118 b. «Kolorit», Xarikov. 2004. 158 s.
2. Ziyodulla, J. (2022). ENHANCEMENT OF PORTLAND CEMENT CLINKER ACTIVITY USING INDUSTRIAL WASTE INCLUDING GYPSUM. Galaxy International Interdisciplinary Research Journal, 10(11), 1102-1104.
3. Ziyodulla, J. (2022). COMPOSITION, STRUCTURE AND PHYSICAL-CHEMICAL PROPERTIES OF PHOSPHOGYPSUM. Galaxy International Interdisciplinary Research Journal, 10(11), 1105-1107.
4. Maxmudova N.A. Bog‘ lovchi moddalar T., TAQI, o'quv qo'llanma 2012. - 118 b. «Kolorit», Xarikov. 2004. 158 s.

5. Abduhalimzoda, Abdurahimov Abdukarim. "TECHNOLOGY OF PREPARATION, TRANSFER AND PLACEMENT OF FILLING MIXTURES." *Galaxy International Interdisciplinary Research Journal* 10.11 (2022): 1098-1101.
6. Abduhalimzoda, Abdurahimov Abdukarim. "STUDY OF PRODUCTION OF LIGHTWEIGHT CONCRETES BASED ON EXPANDED CLAY." *American Journal of Pedagogical and Educational Research* 13 (2023): 19-22.
7. Turapov, F. Kh. "USE OF HEAT INSULATION WALL MATERIALS IN CONSTRUCTION." American Journal of Technology and Applied Sciences 5 (2022): 27-30.
8. Kh, Turapov F., et al. "Features Of The Structure Formation Of A Filling Mixture Based On Industrial Waste."
9. Abdumo' minov O.R.. "EFFICIENT USE OF LOCAL WASTE IN THE PRODUCTION OF BUILDING MATERIALS" International Scientific Research Journal (WoS). I2776-0979, Volume 3, Issue 8, Aug., 2022. 374-376
10. Abdumo' minov, Odina, and Ramazon Rajabov. "PROSPECTS FOR CONSTRUCTION MATERIALS PRODUCTION." *International Bulletin of Engineering and Technology* 3.6 (2023): 23-27.
11. Ilhomova, Ziyodullayeva Madina. "THE EFFECT OF A CHEMICAL ADDITIVE ON THE PROPERTIES OF A CONCRETE MIX." *Academicia Globe: Inderscience Research* 3.5 (2022): 1-2.
12. Ilhomovna, Ziyodullayeva Madina. "Classification Of Work on White Cement in The Production of Marble Quarry Waste and Barium Products Based White Cement." *Texas Journal of Multidisciplinary Studies* 3 (2021): 70-71.
13. Ilhomovna, Ziyodullayeva Madina. "OBTAINING COLD-RESISTANT BARIUM CONCRETE BASED ON WHITE CEMENT USING MARBLE QUARRY WASTE." *Galaxy International Interdisciplinary Research Journal* 9.12 (2021): 504-505.
14. Rakhimov Sh.T., Khudoinazarova K. J., & Zhovliev Z. (2022). DEVELOPMENT OF OPTIMAL COMPOSITIONS AND RESEARCH OF PHYSICO-MECHANICAL PROPERTIES OF FINE-GRAINED CONCRETE. *Galaxy International Interdisciplinary Research Journal*, *10*(11), 761– 764.