Factors of Preparation of High-Quality Clinker in Rotary Kilns

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ABSTRACT

The effect of the cement clinker baking process on cement strength is studied in the article. The process of formation of clinker, which is a solid inorganic substance composed of cations and anions of various compositions combined with protons and hydroxyl groups in liquid rocks, forms the basis of the composition of cement, and quality cooking factors and the basics of economical use of gas fuel in cooking clinker raw materials.

Keywords: cement, clinker, strength, slurry, raw material flour, rotary kiln, thermal process, material and gas temperatures, alite, belite, alumino ferrite

Introduction

Portland cement is widely used as the main material in modern construction. Foundations and floors, roofing tiles and lifting devices, various reinforced concrete and reinforced concrete products, asbestos-cement products, etc. are obtained from it. Cement is a mineral powder that is first mixed with water or a liquid, plasticized, formed into a slurry, and turns into a hard stony rock over time [1-7]. The strength of buildings and structures depends greatly on the technological processes of baking cement clinker. A mixture made of natural limestone and soil (slurry in the wet method, raw flour in the dry method) is baked at a high temperature. During the cooking process, the chemical elements in the raw materials enter into mutual chemical reactions that take place in a certain sequence under the influence of heat, and as a result, a cement clinker is formed [8-13].

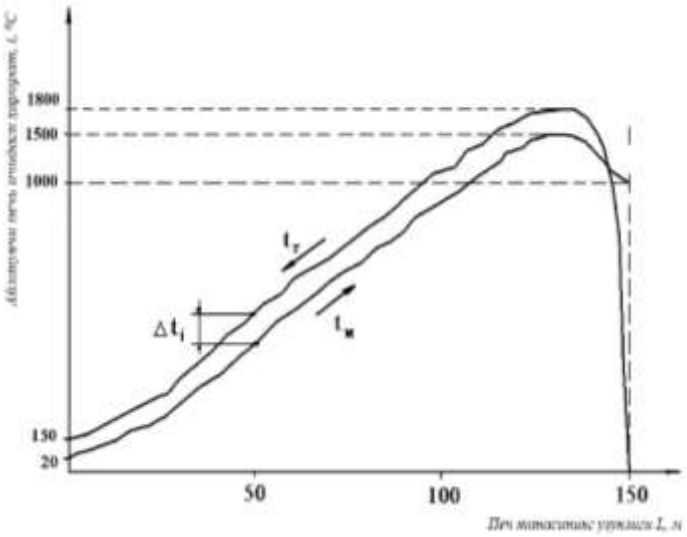
The purpose of the study. A high-quality clinker firing in rotary kilns study factors. Figure 1 shows the temperature change of the material and gases along the length of the rotary kiln. There is a temperature difference between the oppositely moving material and heating gases at each point along the length of the kiln, and this difference is the driving force of the process. serves as strength.

Methodology

Baking of cement clinker is done in rotary kilns. In addition to the advantages of rotary kilns, such as compliance with standard requirements for clinker sizes, high strength, and ample opportunity for free cooking inside the kiln, the baking process is difficult due to the lack of expansion in the composition of the clay-soil compound, and the materials do not stick to each other. has disadvantages such as In order to eliminate these shortcomings, it is necessary to pay attention to the installation and assembly of the furnace, and the efficient and economical use of gas fuel. Furnaces work on the principle opposite to the flow of raw materials [14-19]. Filling the furnace with the material is 7-15%. 20-90 horsepower is required to operate the furnace. The furnace is

installed at a slope of 2-5 degrees relative to the horizon [20-27]. The oven drum rotates at a speed of 0.5-1.3 times per minute. A cooler is installed in the lower part of the oven. The cooler reduces the temperature of the clinker leaving the furnace from 900 ℃ to 50-80 ℃.

The raw material from the upper end of the furnace moves towards the lower end due to the tilting and rotation of the furnace, and the opposing gases (generated by the combustion of fuel) give their heat to the raw material.



Picture 1. Temperatures of material and gases inside the furnace.

In the process of heating raw materials, the following physical and chemical changes occur:

1) Physically bound water in the raw material evaporates when heated to 150℃.

2) When heated to 150 ÷ 750 ℃, the molecular-bound water in the raw material is released.

3) When heated to 750 ÷ 1050 ℃, the decarbonization reaction takes place and calcium oxide is formed in the raw materials:

$$Ca\ SO_3 \rightarrow SaO + SO_2 \uparrow \quad (1)$$

At the same time, SiO_2 and Al_2O_3 are separated in the soil here in pure form and the following chemical reactions take place:

$$CaO + SiO_2 = CaO \cdot SiO_2 \quad (2)$$

$$CaO + Al_2O_3 = CaO \cdot Al_2O_3 \quad (3)$$

$$CaO + Fe_2O_3 = CaO \cdot Fe_2O_3 \quad (4)$$

4) When raw materials are heated to 1050÷1300 ℃, the following exothermic chemical reactions take place in sequence:

$$2CaO + CaO \cdot SiO_2 = 2\ CaO \cdot SiO_2 \quad (5)$$

$$2CaO + CaO \cdot Al_2O_3 = 3\ CaO \cdot Al_2O_3 \quad (6)$$

$$3CaO + CaO \cdot Fe_2O_3 = 4\ CaO \cdot Fe_2O_3 \quad (7)$$

5) When the raw material is heated to 1300 ÷ 1450 ℃, the product partially melts, that is, it ripens. The main component of Portland cement clinker is tricalcium silicate $3CaO \cdot SiO_2$ is considered and it must be in the form of well-formed average crystals in the clinker, which is done at the expense of rapid burning and rapid cooling of the clinker [28-35].

6) As the material cools from 1450 ℃ to 1000 ℃, the solution crystallizes. Cooling of clinker to temperatures below 1000 ℃ is done in grid coolers.

Results

We have conducted research on the economical use of gas fuel in cooking clinker raw materials. The experimental setup and the measured points are shown in Figure 1.2.

The cooking time of clinker in rotary kilns is 35-40 minutes, and during the first 18-20 minutes, 1050-1300 ℃ heated to a temperature of 1400÷1450 for 2-4 minutes℃is increased to, cook at this temperature for 10÷12 minutes, then in 2-3 minutes at 1000-900 ℃ cooled to In order to prevent the granules from sticking to each other and to the lining inside the furnace, the maximum temperature during expansion is 1450 ℃ not exceeding, the temperature range of expansion is 50÷70 ℃ should not be less than

High-quality clinker in furnaces depends on the order of firing, cooling processes, granule composition and gas conditions.

Thermal treatment of granule raw materials also depends on the condition of gases in the furnace.

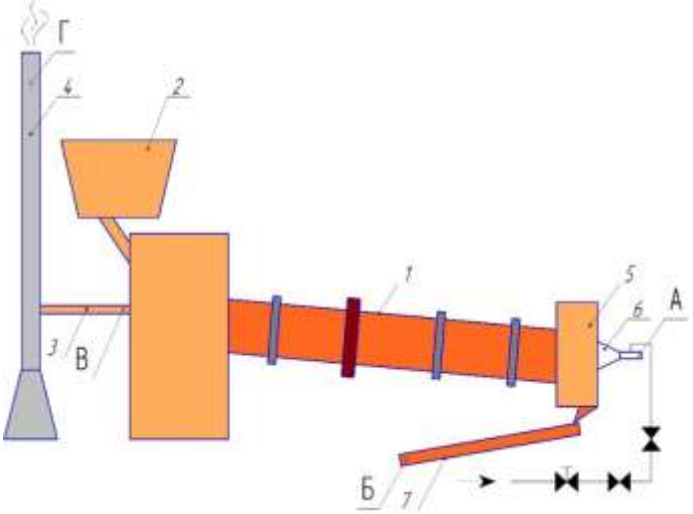


Fig. 2. Dimensional drawing of a clinker kiln

Points measured during the experiment.
A-pressure of the gas coming to the gas burner;
B-clinker production capacity of the furnace;
V-reduction of heating gas along the furnace;
G-the temperature of the heating gas leaving the furnace.
1-rotary clinker kiln;
2-transfer of pellets to the furnace;
3-gas lane;
4- smoke outlet pipe;
5-the lower part of the oven;
6-gas burner;
7-cooling drum.
The amount of heating gas and air supplied to the drum furnace under pressure moves towards the centerless part of the furnace during its operation. Depending on the temperature change, rotary kilns can be conditionally divided into the following intermediate areas:
1. In the heating intermediate area, the raw material is heated to 150 °C.
2. Construction intermediate area or gas temperature 150÷750 °C and the temperature of the material is 40÷240 °C moisture separation in the limit. The length of the construction interval is 25÷36% of the total length of the furnace, depending on the time required for the porosity, moisture and expansion of the granule raw material.
3. Decarbonization process area. In this case, the gas temperature is 1050÷1250 °C and the temperature of the material is within the limit of 240÷880. In the process of heating the material, heat is transferred from the heating gas to the material being heated. The length of the heating area is 20÷32% of the total length of the oven.
4. Area of clinker cooking process. In this process, the gas temperature in the oven is 1300-1450 °C and the temperature of the material is 880-1160 °C is, and in this case, the gas release continues from the expansion of the clinker granule being baked. The intermediate area of the cooking process is 15-20% of the total length of the oven.
5. The initial cooling process of baked clinker corresponds to the arrival process of the secondary air brought to the furnace. In this intermediate area, the oxidation of various iron compounds on the surface of the granule has a brown and red appearance. The temperature during cooling of the granule is 1000÷1050 °C decreases to The intermediate area of the cooling process does not exceed 5% of the total length of the furnace.

Conclusion

- for the formation of cement clinker, a mixture with a certain chemical composition must be heat treated according to technological regulations;
- trimolecular calcium silicate (allite) is considered a chemically active mineral, which has a decisive effect on the strength and hardening speed of cement;
- alite has the property of quick hardening and high strength, therefore, its increased amount in the cement ensures the production of the same clinkered high-quality portland cement;
- two molecules of calcium silicate (belite) dissolved in water harden slowly in the initial period and release heat. During the first month, the solidification strength will not be very high, but under favourable conditions, the strength will continuously increase for several years;
- trimolecular calcium aluminate has a high chemical activity, releases a large amount of heat of hydration during the first solidification period, and solidifies quickly.
- four molecules of calcium aluminoferrite emit moderate heat, it solidifies more slowly than alite, but more quickly than belite. The

consistency of the products it hydrates is slightly lower than that of alite.

References

1. Loskutov Yu. A. i dr. (1986). Mechanicheskoe oborudovanie predpriyatiy po proizvodstvu vyajushchih stroitelnyx materialov. *M.: Mashinostroenie*. 376 p.
2. Alekseev B. V. (1980). Cement production technology. *M.: Vysshaya school*. 264 p.
3. Bogdanov V.S., Bulgakov S.B., Ilin A.S., Krot A.Yu. Technological complexes and mechanical equipment of enterprise construction industry: ucheb. Belgorod: *Izd-vo BGTU,* 2008. 528 p.
4. Bogdanov V. S., Sharapov R. R., Fadin Yu. M., Semikopenko I. A., Nesmeyanov N. P., Gerasimenko V. B. Osnovy raschyota mashin i oborudovaniya predpriyatiy stroitelnyx material i izdeliy: uchebnik. Staryy Oskol: TNT, 2013. — 680 p.
5. Komilova, K. (2022). Analysis of devices used in the technological process. Eurasian Journal of Academic Research, 2(7), 106-111.
6. Хурсанов, Б. Ж., & Алиматов, Б. А. (2020). Экстракционное извлечение редких металлов из отвалов ГОК. Universum: технические науки, (6-1 (75)), 42-45.
7. Хурсанов, Б. Ж., & Абдуллаев, Н. Қ. (2022). Газ миқдорларини экстракциялаш жараёнининг самарадорлигига таъсири. Eurasian Journal of Academic Research, 2(6), 321-324.
8. Хурсанов, Б. Ж., & Хонкелдиев, М. А. (2022). Энергиятежамкор контакт вақти узайтирилган барботажли экстрактор. Eurasian Journal of Academic Research, 2(6), 115-117.
9. Khursanov, B. J. (2022). Methods for calculating the economic efficiency of new technology. World Economics and Finance Bulletin, 10, 112-116.
10. Хурсанов, Б. Ж., & Алиматов, Б. А. (2020). Экстракционное извлечение редких металлов из отвалов ГОК. Universum: технические науки, (6-1 (75)), 42-45.
11. Khursanov, B. J. (2022). Extraction of rare metals from mining dumps in bubbling extractors. American Journal Of Applied Science And Technology, 2(05), 35-39.
12. Хурсанов, Б. Ж., & Алиматов, Б. А. (2022). Исследование Взаимного Уноса Фаз В Барботажном Экстракторе С Увеличенным Временем Контакта. Central asian journal of theoretical & applied sciences, 3(5), 28-33.
13. Дусматов, А. Д., Ахмедов, А. Ў., Абдуллаев, З. Ж., & Гапаров, К. Г. (2022). Междуслоевые сдвиги двухслойных комбинированных пластин и оболочек с учетом усадки композитных слоев. Oriental renaissance: Innovative, educational, natural and social sciences, 2(4), 133-141.
14. Алиматов, Б., Каримов, И. Т., Садуллаев, Х. М., & Хурсанов, Б. Ж. Экстракционная установка с барботажным экстрактором.
15. Xursanov, B., Latifjonov, A., & Abdulhakov, U. (2021). Application of innovative pedagogical technologies to improve the quality of education. Scientific progress, 2(7), 689-693.
16. Xursanov, B., & Abdullaev, N. (2021). Fundamentals of equipment of technological processes with optimal devices. Scientific progress, 2(7), 679-684.
17. Xursanov, B., & Akbarov, O. (2021). Calculation of gas volume in the mixing zones of extended contact time barbota extractor. Scientific progress, 2(7), 685-688.
18. Алиматов, Б. А., Соколов, В. Н., Салимов, З. С., & Хурсанов, Б. Ж. (2003). Исследование распределения капель по размерам в многоступенчатом барботажном экстракторе. Журнал прикладной химии, 76(8), 1309-1311.
19. Алиматов, Б. А. (2020). Металлургия и материаловедение. Главный редактор: Ахметов Сайранбек Махсутович, д-р техн. наук; Заместитель главного редактора: Ахмеднабиев Расул Магомедович, канд. техн. наук; Члены редакционной коллегии, 42.
20. Karimov, I., Boykuzi, K., & Madaliyev, A. (2021). Volume-Surface Diameters of Drops in Barbotaj Extractor. International Journal of Innovative Analyses and Emerging Technology, 1(5), 94-99.

21. Xursanov, B. J., Mamarizayev, I. M. O., & Akbarov, O. D. O. (2021). Operation of mixing zones of barbotage extractor in stable hydrodynamic regime. Scientific progress, 2(8), 170-174.
22. Xursanov, B. J., Mamarizayev, I. M. O., & Akbarov, O. D. O. (2021). Application of constructive and technological relationships in machines. Scientific progress, 2(8), 164-169.
23. Xursanov, B. J., Mamarizayev, I. M. O., & Abdullayev, N. Q. O. (2021). Application of interactive methods in improving the quality of education. Scientific progress, 2(8), 175-180.
24. Isomidinov, A., Boykuzi, K., & Khonnazarov, R. (2021). Effect of Rotor-Filter Device Operation Parameters on Cleaning Efficiency. International Journal of Innovative Analyses and Emerging Technology, 1(5), 100-105.
25. Isomidinov, A., Boykuzi, K., & Madaliyev, A. (2021). Study of Hydraulic Resistance and Cleaning Efficiency of Gas Cleaning Scrubber. International Journal of Innovative Analyses and Emerging Technology, 1(5), 106-110.
26. Алиматов, Б. А., & Хурсанов, Б. Ж. (2008). Технические основы создания машин.
27. Алиматов, Б. А., & Хурсанов, Б. Ж. (1998). Расчет величиныотстойной зоны барботажного экстрактора. Науч. техн. журн. Ферг. политехн. ин-та. Фергана, 1(2), 86-89.
28. Alimatov, B., & Khursanov, B. (2020). Analysis of droplets size distribution and interfacial surface during pneumatic mixing. Asian Journal of Multidimensional Research (AJMR), 9(6), 165-171.
29. Алиматов, Б. А., Соколов, В. Н., & Хурсанов, Б. Ж. (2001). Влияние газосодержания на производительность барботажного экстрактора по тяжелой жидкости. НТЖ ФерПИ, Scientific-technical journal (STJ FerPI), 2, 93-94.
30. Ахунбаев, А. А., Туйчиева, Ш. Ш., & Хурсанов, Б. Ж. (2020). Учёт диссипации энергии в процессе сушки дисперсных материалов. Universum: технические науки, (12-1 (81)), 35-39.
31. Дусматов, А. Д., Хурсанов, Б. Ж., Ахроров, А. А., & Сулаймонов, А. (2019). Исследование напряженно деформированное состаяние двухслойных пластин и оболочек с учетом поперечных сдвигов. In Энерго-ресурсосберегающие технологии и оборудование в дорожной и строительной отраслях (pp. 48-51).
32. Мирзахонов, Ю. У., Хурсанов, Б. Ж., Ахроров, А. А., & Сулаймонов, А. (2019). Применение параметров натяжного ролика при теоретическом изучении динамики транспортирующих лент. In Энерго-ресурсосберегающие технологии и оборудование в дорожной и строительной отраслях (pp. 134-138).
33. Алиматов, Б. А., Садуллаев, Х. М., Каримов, И. Т., & Хурсанов, Б. Ж. (2008). Методы расчета и конструирования жидкостных экстракторов с пневмоперемешиванием.
34. Khursanov, B. J. (2022). An Innovative Approach to the Design of Technical and Technological Processes of Production. Eurasian Research Bulletin, 11, 15-19.
35. Khursanov, B. J. (2022). The Factors of Ensuring Sustaining Manufacturing Competitiveness. *Eurasian Journal of Engineering and Technology*, *9*, 93-100.