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ANALYSIS OF THE MAIN TECHNOLOGICAL STAGES IN THE PREPARATION OF CEMENT

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ANNOTATION: At the global level, in the stages of the development sequence of the modern world, the demand for construction materials is increasing, and the increase in the number of construction products of various compositions shows significantly high indicators. It was precisely because of the large production capacity of portland cement that our interest increased. Our scientific research is aimed at improving the cement production technology and producing high-quality construction products. Our research in this field was conducted in small laboratory conditions.

Key words: clinker, cement, furnace, mixture, heating, raw materials, rocks, technology.

Introduction:Cement is a powdery substance used to form solids with water, in a soft and pasty state (hardens when dry) for bonding. In construction, it is a binding substance that forms composite concrete together with bricks and stones. Portland cement is a material containing lime and silicates mixed with calcined sand and stone and, after hydration, forms a plastic material that hardens like rock. Portland cement is produced in a number of processes as shown in Figure 1:[1].

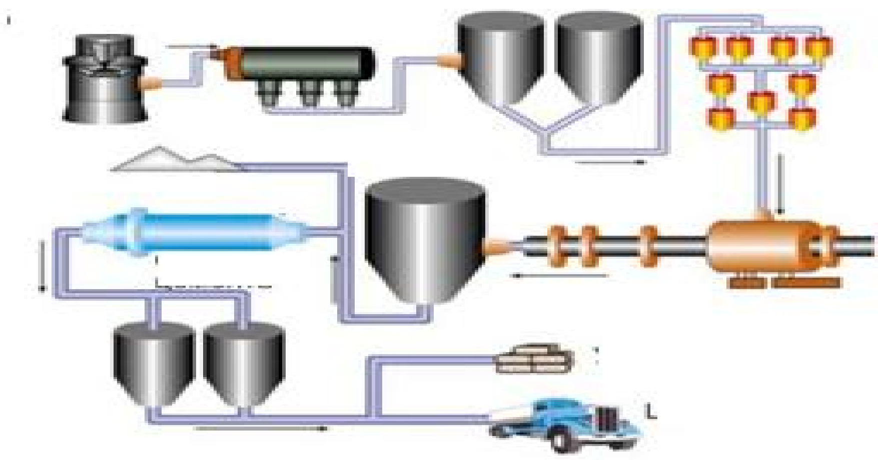

Figure 1. Cement production process.

Methods: In the process of cement production, raw materials are crushed using special mills, at the next stage they are passed through electrostatic filters, and with the help of this mill, raw materials are mixed in the specified proportions. clinker is collected in a clinker collecting tank and clinker is mixed with gypsum raw materials in a mill and crushed into small pieces, the resulting product is packed as portland cement[1-2].

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Results: Limestone (calcium carbonate) and other materials containing appropriate proportions of calcium, silicon, aluminum and iron oxides are crushed and ground into powder-like raw materials. Powdered products are baked in an oven, first of all, the process of separating calcium carbonate into calcium oxide with the release of carbon dioxide is carried out through this reaction.

$CaCO_3 \rightarrow °C\ CaO + CO_2\uparrow$ then calcium oxide reacts with other components to form calcium silicates and aluminates, which partially combine at the melting temperature of the material up to 1450°C. The reaction products leave the furnace as a black or gray colored material, clinker[3].

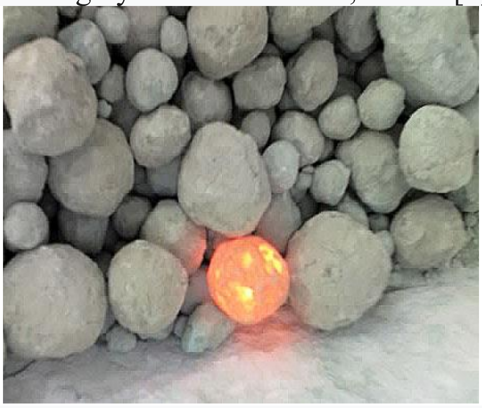

Figure 2. The resulting clinker product.

This is finally mixed with a small amount of clinker gypsum (to control the rate of hydration) and forms a fine powder product that is cement[4].

Figure 3. Ready cement product.

Discussion: The composition of raw portland cement varies from plant to plant due to the cement properties and the mineralogy of the materials available. This is a process related to the difference in the chemical composition of the minerals used in each plant. In general, a eutectic mixture is produced which minimizes the heat input required for clinkering and the total consumption of raw materials, while producing a cement of acceptable performance.

1-Table. Approximate analysis of raw mix for clinker:

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№	Components	Amount of components
1	CaO	65-68 %
2	SiO_2	20-23%
3	Al_2O_3	4-6%
4	Fe_2O_3	2-4%
5	MgO	1-5%
6	Mn_2O_3	0.1-3%
7	TiO_2	0.1-1%
8	SO_3	0.1-2%
9	K_2O	0.1-1%
10	Na_2O	0.1-0.5%

Note that if the bulk of the raw mixture is $CaCO_3$, heating in a furnace or laboratory furnace will convert about 35% by weight to CO_2; this results in approximately 1.5 times the raw material requirement for cement production, and also requires analytical data to clearly differentiate between "raw" and "heated" bases[8].

Cement production begins with the extraction of raw materials in the quarry and their transportation to the factory. Quarrying can be done by cutting or by drilling and blasting. In any case, the recovered material must be of consistent quality, and the necessary level of mine planning is facilitated by drilling excavations throughout the mine area or by pit analysis when drilling blast holes[5].

Cement mixes vary from a single component "cement rock" containing appropriate proportions of all required minerals when mined, to 4 or 5 component mixes consisting of one or two grades of limestone, shale or clay. More additives to increase the level of SiO_2, Al_2O_3 or Fe_2O_3.

Kiln feed typically contains 78-80% $CaCO_3$, so limestone can only approach this level if it contains other ingredients. It is important to have enough flux (Al, Fe, Mg, F) to ensure fusion in the furnace, but MgO should not exceed 4-5%, otherwise the cement may expand. Excessive alkalis (K, Na) affect the operation of the oven and the quality of the product. Excessive heat will cause the kiln to build up and restrict the gypsum addition, which can cause installation problems. The stoichiometric ratio of alkali to sulfur is usually kept in the range of 0.8-1.2. Excessive Cl causes serious build-up problems for preheater operation[6].

2- Table. Typical proportions of mined materials:

№	Composition of raw mixtures	The amount of mixtures
1	Limestone CaO	85%
2	Shale or clay SiO_2, Al_2O_3 va Fe_2O_3	13%
3	Attachments SiO_2, Al_2O_3 or Fe_2O_3	to <1%

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Typically, cement plants are located in limestone deposits, and shale or clay is common enough for most plants to mine this locally. Supplements are usually brought in, albeit in small amounts. Mining plans are developed according to the geology of the materials. If the limestone is not homogeneous, it may be necessary to mix stones from different areas to maximize recovery. In addition, selective mining may be necessary to avoid problems such as low-grade materials or alkalis. Mining and transportation are generally controlled by[7].

Conclusion: All production and inventory should be kept as dry as possible, with sufficient conditions for each ton of cement, but the moisture level of the mined raw materials transported and crushed rock should be taken into account. In addition to chemical, physical characteristics, grinding is also the main factor in the selection of raw materials. In conclusion, silicate inclusions containing coarse-grained quartz are very difficult to grind, and hard silicates are difficult to bake at high temperatures. If quartz-silicon dioxide is used, it is proven to be preferable. The volume of natural raw materials, i.e., the level of grinding, should be less than 50% micro. We tested this process in laboratory conditions.

a) b) c) d)

Fig. 4. a) raw material grinding mill b) quartzite raw material c) crushed raw material, drawing of raw material on an electronic scale d) method of determining the level of fineness in a 0.08 sieve.

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