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The Oxide Composition with a Controlled Expansion of Cement

Iya Germanovna Luginina, Andrey Viktorovich Cherkasov and Roman Andreevitch Cherkasov

Belgorod State Technological University Named after V.G. Shukhov,
Kostyukov Street, 46 308012, Belgorod, Russia

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Abstract: Great scientific interest and practical importance are expanding non-shrink and bend the cement. They are characterized by a uniform, which occurs early in life extension, which compensates for their subsequent shrinkage, which addresses one of the challenges in the field of cement-prevention of negative shrinkage deformation. Expanding most famous cement is due to the formation of calcium hydrosulfoalyuminata. Temperature range expanding cements containing in its composition and gypsum calcium aluminates is within 20-80°C. As an expanding additive may be used oxides of calcium and magnesium for expanding cements. However, their use may be effective if the calcium and magnesium oxides are burned at low temperatures. Such materials react rapidly with water to form hydrates, the volume of which is 2 times more than the amount of starting materials, which, according to the authors and causes the expansion of the cement stone. Getting the emerging and non-shrink cement magnesium oxide and calcium has not received wide acceptance due to the lower scrutiny of the conditions for obtaining MgO and CaO, hydration which, under certain conditions, leads to the expansion of cement. Expanding plugging materials are increasingly used in the construction of wells.

Key words: Expanding cement・Expanding composition・Calcium oxide・Magnesium oxide

INTRODUCTION

Since the shrinkage phenomenon worsen construction specifications mortar and concrete, scientists of many countries have long sought to create a cement that not only would not give shrinkage and, conversely, would cause the expansion of cement in the process of hardening. The study of the mechanism of hydration and expansion of binding systems in the presence of CaO, MgO, in particular demands the development of researchers in view of the contradictory judgments on this issue [1-5].

The main efforts of many researchers were directed to study the reaction of hydration of substances which are the increase in volume during the formation high sulfate hydrosulfoalyuminata form calcium hydroxide or calcium or magnesium [6]. An analysis of domestic and foreign information indicates that the vast majority of produced and offered to release expanding additives is mainly composed of calcium sulfoaluminate free calcium oxide or contains together, these two components [7].

In the literature, there is limited information on the mechanism of action of CaO and MgO as expanding additives. However, use of cement on the basis of the oxide is very promising, since hydrated oxides of calcium and magnesium compounds are stable and do not undergo a cement stone no phase transformations leading to disruption of the structure and the strength of recessions. It is known that calcium oxide and magnesium hydration significantly increased in volume. This property should preferably be used to create an expanding additive obtained by firing carbonate materials.

Currently particularly urgent problem associated with raw materials. Most quarries pure calcium carbonate is already developed, pure limestone at the end, so it became necessary to study the dolomite and dolomitic limestone [8].

The Purpose of the Study: Work out the technologies of the expanding cement additives, based on a modified dolomitic lime.

In accordance with the intended purpose it was necessary to solve the following problems:

Corresponding Author: Iya Germanovna Luginina, Belgorod State Technological University Named after V.G. Shukhov, Kostyukov Street, 46 308012, Belgorod, Russia.

- To study the dissociation of dolomite and dolomitic limestone with the investigation of the microstructure calcine.
- Study the effects of additives on the mineralizing temperature calcination, intensity of hydration and volume strain.
- Examine the mechanism of the expansion joint and hydration of calcium and magnesium oxides.
- Explore the possibility of expanding the use of new songs for non-shrink and expanding cements.

The Study of the Dissociation of Dolomite: For studies in the use kovrovskiy, Lipetsk dolomites and dolomitic limestone Volosovskiy. Chemical composition of raw materials shown in the table. Mineral components calcination and hydration products investigated X-ray diffraction, differential thermal methods, as well as by microscopy.

Differential thermal analysis of dolomitic limestone powder, showed a typical thermogram of the natural decomposition of carbonates.

These DTA shown in Fig. 1 a, b, c, d, e, f. The first endothermic peak at 780°C-750°C-800°C corresponds to the decomposition of dolomite with simultaneous dissociation of magnesium carbonate and the allocation of $CaCO_3$, the second at 880°C-920 °C corresponds to the dissociation of calcium carbonate. Observed for the different samples of dolomitic limestone uneven nature of the differential curve explained by the different decay rates of the molecules, which depends on the degree of perfection of the crystal structure of the mineral and the presence of impurities.

Subsequent experiments devoted to the study of the mechanism of decomposition of dolomite adding Na_2CO_3. In the curves in Fig. 1.d, e, f, recorded two endothermic maximum shifted to a lower temperature: first-at 635... 690°C, the second-at 800-880°C.

Introduction Na_2CO_3 additive lowers the temperature of the dissociation of the investigated dolomite: Kovrovskogo at 95°C, to 90° C Volosovsky, Lipetsk at 110°C. It is noted that the differential curve changes its original direction is not sharp, but gradually.

Dolomite begins to decompose when adding Na_2CO_3 at 450-500°C. Adding Na_2CO_3 reduces the temperature of dissociation evolved $MgCO_3$ 90-110°C. When firing with the addition of Na_2CO_3 the selection of the first portions of MgO occurs at 450°C.

According to X-ray analysis of dolomite decomposition and release of calcium carbonate (d = 3,038; 2,27; 1,910 Å) starts to 700° C with simultaneous evolution of magnesium oxide (d = 2,11; 1,48 Å).

At 900°C individual particles of magnesium oxide and calcium are separated from the total weight to form on the surface of differently-minute flakes, crystal dimensions 0.2-2 microns. This structure of hydration activity, rate of hydration of cake will be largely determined by the rate of hydration of small crystals.

In the presence of additives Na_2CO_3 dissociation $CaMg(CO_3)_2$ begins by heating below a temperature of 500°C. Firing in the presence of Na_2CO_3 at a temperature of 600°C leads to formation of an uneven structure with alternating small crystals of MgO. Consequently, Na_2CO_3 reacts with carbonate prior to dissociation, despite the relatively limited its content and lowers the temperature of decarbonization.

In order to establish the possibility of using dolomite cakes of different composition as a spreading additives to portland cement, determined their hydration activity (kinetics of heat). Fig. 2 shows the results of observations of dolomitic lime hydration activity obtained Kovrovskogo calcining dolomite and simultaneously with the addition of Na_2CO_3 at a temperature of 900° C. Maximum hydration activity has no additional calcined dolomite.

Active hydration of lime with the addition of Na_2CO_3 significantly reduced (Fig. 2, b) compared with hydration activity without added lime. Quenching (hydration) continued for 20 minutes with the heating of the mass of up to 38°C.

Hydration activity of dolomite adding Na_2CO_3 significantly reduced, due to the formation of a protective film of tumors, enveloping surface of the crystals of magnesium oxide and calcium and prevents the penetration of water to the surface of the crystals. This causes the formation of slowly extinguishing the lime at lower firing temperatures of about 900°C.

The most characteristic physical and mechanical properties of the expanding composition (EC) is a free linear expansion and stress itself and, except for the value of the free thermal expansion and stress itself great importance growth dynamics of these characteristics.

To determine the change in volume strain in free expansion of the Lipetsk dolomite, took measurements, using the indicator of hour type of linear expansion of Figure 3.

Figure 4 shows the amount of change in volumetric strain EC time at 20°C. It can be seen that the expansion starts with the mixing and intensively flows for 6 hours and then slows down. Expansion, gradually fading, continued throughout the period of observation, 24 hours later stopped the experiment because with a strong increase measurement accuracy is reduced, due to

Table 1: The chemical composition of raw materials

No	Komponent	Oxide content, %								
		SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	SO_3	L.O.I.	Amount
1	Dolomite kovrovskiy	5,21	1,10	0,67	29,65	18,21	0,43	0,51	43,44	99,62
2	Dolomite lipetskiy	2,89	0,64	0,61	31,55	18,70	-	0,40	45,05	99,84
3	Volosovskiy dolomitic limestone	2,03	0,01	след	33,13	16,00	-	0,36	45,00	96,53

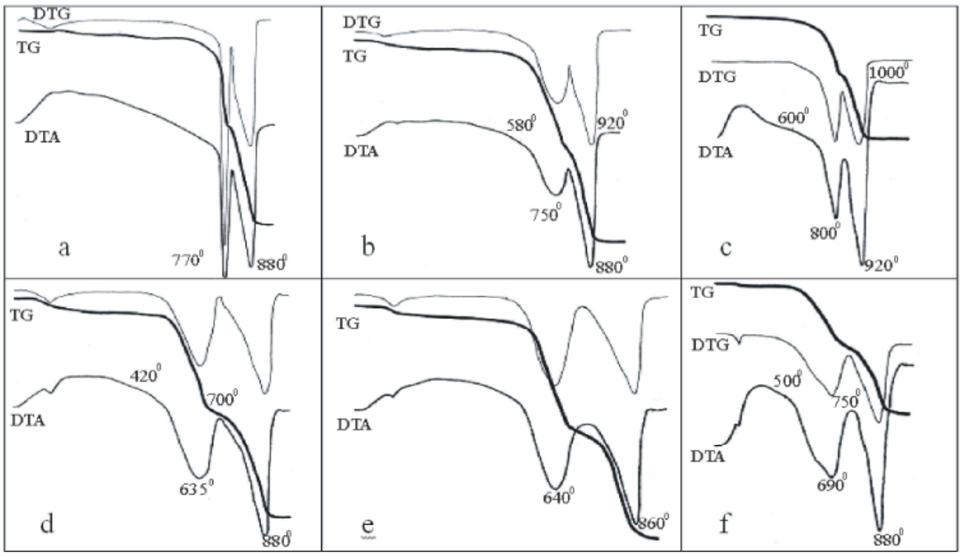

Fig. 1: Thermogram of dolomite:
a-kovrovskiy; b-lipetskiy; c-volosovskiy;
with additives $Na_2CÎ_3$:d-kovrovskiy; e-volosovskiy; f-lipetskiy

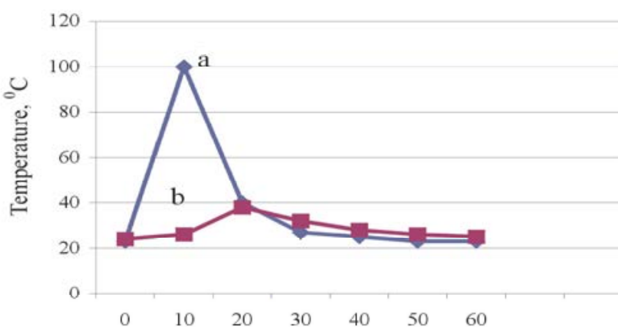

Fig. 2: Hydration activity dolomitic lime obtained by calcining at 900° C: no additive (a); with the addition of Na_2CO_3 (b)

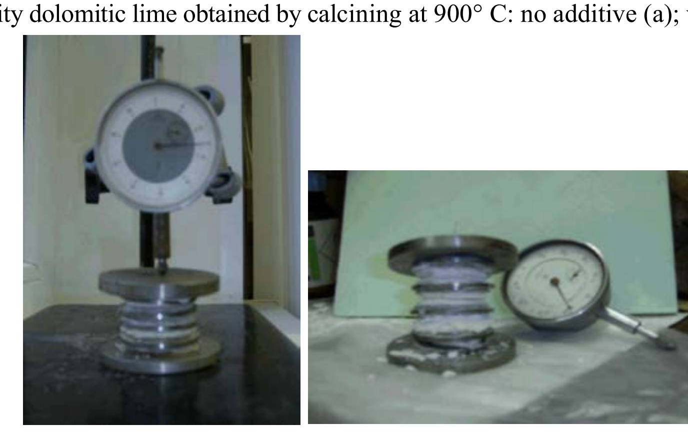

Fig. 3: Expansion of the E. C. in the ring-shaped

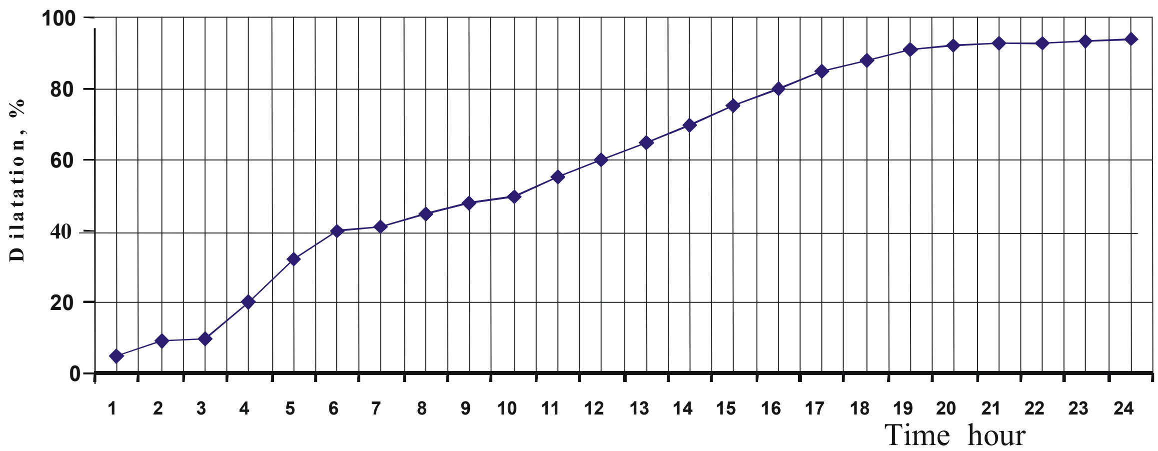

Fig. 4: Volume of the expanding deformation composition

misalignment of rings and the indicator probe offset from the center of the lid. In this case, found that in the absence of external constraints free expansion was 94% after 24 hours.

It is known that the possibility of expanding cements when administered CaO or MgO [9, 10]. Since hydration reaction of quicklime proceed rapidly, it is necessary to slow down the process of interaction of CaO and MgO with water, otherwise expanding deformation will occur in yet plastic cement paste and create a spreading effect.

The expandable composition (EC.) dolomite prepared by burning Lipetsk supplemented with Na_2CO_3 at a temperature of 950 °C, 60 min. Product firing ground to complete passage through a sieve 008.

The effect of mode of hardening cement paste, adding the composition to the expanding strength indices at the three curing modes: autoclave, steaming and water under normal conditions.

The results of physical and mechanical tests of samples showed that the introduction of additives EC is effective when administered at 3% cement is increased compressive strength. Introduction 10% EC destroy the samples. The value of linear expansion with the addition of cement made by adding 3%-0,13%, such an extension is safe for the strength of the cement, the addition of 10%-6,40%. Large expansion is accompanied by severe degradation of cement and decreased strength. With an excess of EC strong degradation of cement ends with the complete destruction of the samples.

Summary: Established chemistry interaction between natural double carbonate with catalytic additives such as alkali metal salts of: additive reacts with one of the carbonates forms a complex compound. The newly formed complex dissociates at relatively low temperatures with the release of CO_2 and oxide liberated by the decomposition of alkaline additive is able to respond back with a second carbonate while reducing its dissociation temperature. As a result, the temperature drops decarbonization double carbonate of 130-110°C.

This paper studied the effect of salt additives on the properties of dolomitic lime, which has a central ion ionic radius close to the ions Mg^{2+} and Ca^{2+}. With increasing concentration of additive to dolomite reduced thermal activity at dolomitic lime slaking.

The theoretical justification for the maximum possible concentration of the additives of alkali carbonates which are significantly lower hydration activity burned dolomite. The greatest influence on the hydration has a sodium carbonate.

The intensity of the volume strain of dolomitic lime hydration are controlled in time and acquire properties that allow them to use in expanding compositions. The addition of sodium to dolomite adipinata before roasting lowers the hydration activity of oxides of magnesium and calcium.

The technology of the new composition of the expanding (EC) to the plugging solution. EC additive obtained on the basis of dolomite is effective when administered into cement limited due additives may increase the compressive strength increased above a certain concentration addition aisle and can cause unacceptable destruction of cement.

The expansion of the cement can be controlled not only the selection of the number and composition of the expanding component, but also the changing conditions (hydrothermal conditions) forming the basic structure of cement-stone. Adjusting cement dosage of EC, in the binder, with thermal-processing, you can get a cement stone desired extension within certain limits.

Hardening cement with the addition of EC simultaneously flows increase strength cement and parallel to the internal stresses caused by the increase in the expanding component that supplements in excess leads to the development of cracks and structural integrity violation. Most of the expanding phase of Ca $(OH)_2$ and Mg $(OH)_2$ must be formed after the cement stone certain strength (not less than 2-3 MPa), i.e. a semi-rigid structure.

To obtain optimal values of the expansion of cement and the subsequent growth of its mechanical strength, the intensity of these processes should be mutually consistent.

The intensity of the volume strain of dolomitic lime hydration are controlled in time and acquire properties that allow them to use in expanding compositions.

CONCLUSION

Using expandable composition comprising magnesium oxide and calcium dolomite, requires reducing their hydration activity to inhibition of hydration reaction, causing volumetric deformation.

The effect of additives (alkaline carbonates, fluorides, sulfates, sodium adipate as waste) reducing hydration activity burned dolomite. The theoretical justification for the maximum possible concentration of additives that significantly reduce the hydration activity of burnt lime.

Intensity volumetric deformations dolomitic lime during hydration is controlled in time and acquires the properties which are useful in expanding compositions.

The technology of the new composition of the expanding (EC) to the tampon changes require solutions. EC additive obtained on the basis of dolomite is effective when administered in an amount of cement to 3% by addition of increased compressive strength, an increase of content of the additive is unacceptable because it can cause destruction of cement.

Developed a low-power technology is expanding additives from calcined dolomite, in which the sequential hydration of calcium and magnesium oxides is stretched in time sequential deformation of expansion.

The paper studied the possibility of expanding the use of a composition based on a modified calcium oxide and magnesium using alkaline additives for the manufacture of low-shrinkage, or expansion of cement.

On the practical side, you can recommend getting an expanding or non-shrink cement using the resulting widening of the composition.

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