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Technological Scheme of Obtaining Calcium Nitrite

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Abstract: The experiments were carried out on a laboratory setup consisting of a glass reactor equipped with a paddle stirrer, placed in a thermostat; the rotation speed of the electric motor was regulated by a rheostat device and measured with a TM-ZM tachometer using a D-sensor 1 мм. The temperature of the water thermostat heating the reactor was maintained using a contact thermometer TK-300 and an electronic relay RT-230 z with an accuracy of ±10C.

Introduction

The calculated amount of HNO3 was loaded into the reactor. Limestone was gradually added there (within 3–4 min). After loading was stirred for a given time (generally 40 min). Then the resulting mass was quickly poured into a vacuum filtration unit with stirring. The weight method was used to determine the amount of solid and liquid phases.

The required amount of nitric acid for decomposition was calculated using the reaction equation:

$CaCO3 + 2HNO3 \rightarrow Ca(NO3)2 + CO2 + H2O$ (1)

The results of the study of the dependence of the degree of decomposition of limestone on the norm of nitric acid and particle size are presented in (Fig. 1).

Data analysis shows that with an increase in the concentration of HNO3 from 15 to 45%, the degree of decomposition of limestone in 40 minutes increases by 1,15 times, and with a further increase - by 1,12 times.

From fig. 1 also shows that the particle size strongly influences the degree of limestone decomposition. With an increase in particle size from 0,014 - to 2,00 ммthe degree of decomposition of limestone decreases from 87,0; 97,5; 98,5 and 96,5 respectively to 78,0; 79,5; 80,0 and 80,5% for a concentration of 15, 30, 45, 59% HNO3.

From the results of these studies, it follows that with an increase in the concentration of nitric acid, the absolute difference in the degree of decomposition increases from 9,0 to 18,5%. The acceleration of limestone decomposition is explained by an increase in the activity of hydrogen ions of nitric acid and an increase in the contact surface of the reacting components per unit reaction volume.

On the curve of the dependence of the degree of limestone decomposition on the concentration of nitric acid, a bend is observed at an HNO3 concentration of no more than 45% (Fig. 1).

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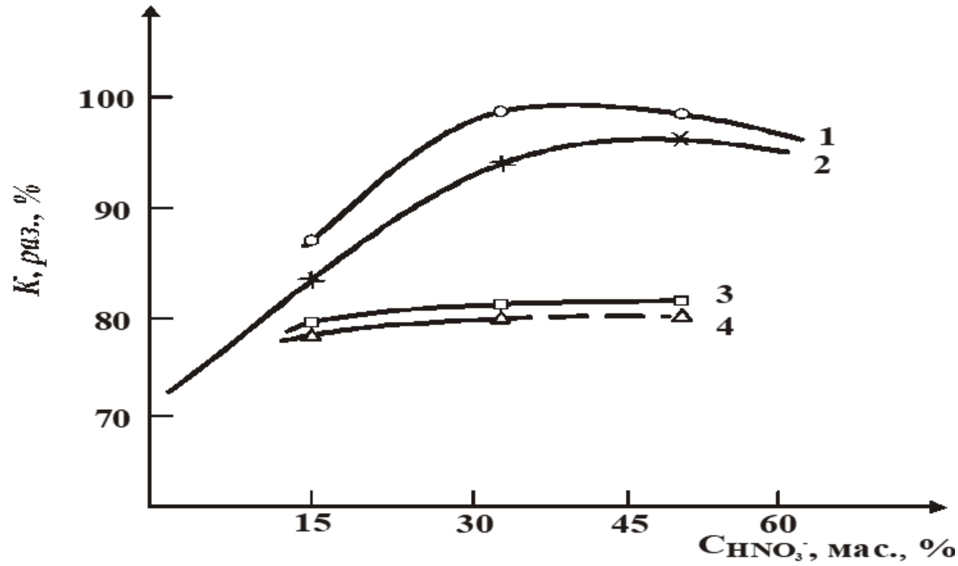

Fic. 1 Influence of the concentration of nitric acid (C , mass. %) on the coefficient of limestone decomposition (K dec.,%) 1- 0,014 mm; 2- 0,64 mm; 3- 1,25 mm; 4-2,00 mm.

This is due to the fact that when using nitric acid with a concentration of more than 45%, a viscous mass is formed, which reduces the degree of decomposition. The acidity of the filtrates, depending on the concentration of nitric acid and the size of CaCO3 particles, ranges from -1,2 ÷ +7,6. The pH values of the solution are associated not only with the degree of decomposition of limestone, but also with the concentration of calcium nitrates in solutions. For example, at a 95% degree of decomposition with a content of 19,97 and 34,62% Ca(NO3)2, the acidity of the solutions is 5,60 and 4,99, respectively.

The content of free nitric acid also significantly affects the acidity of solutions. For example, in sample solutions with approximately the same content of Ca(NO3)2: (59,36 and 59,33%), the pH values are 1,2 and 0,25, respectively, because they have different content of free nitric acid – 0,58 and 0,44, respectively.

On fig. 1 and 2 show the process flow diagram and the material balance for the production of calcium nitrite.

A solution of nitrite - calcium nitrate, obtained as a result of alkaline absorption (pos. 1) is sent to the solvent, where nitric acid is simultaneously supplied (pos. 3, fig. 1). The resulting solutions of nitrite and calcium nitrate with the composition P0 (fig. 4.9) are sent to the evaporator (pos. 5), where they are evaporated at 1200C to a concentration of nitrite and calcium nitrate P1 and monohydrate calcium nitrite begins to crystallize. During isothermal evaporation at 1200C up to the point "P" the composition of the liquid phase corresponds to "P|2". The resulting hot pulp with composition "P" is sent to the mold (pos. 6). Here, when the solution is cooled to 250C, Ca(NO2)2. H2O crystals are released, which are separated from the solution on a drum vacuum filter (pos. 7).

The resulting mother liquor P|3 [45% Ca(NO3)2 and 15,0% Ca(NO2)2] (pos. 9) with the help of a centrifugal pump (pos. 10) is sent to the evaporation or to the consumer as a nitrate - calcium nitrite solution (NNK) as a modifier of antifreeze action.

Optimal conditions for the technological process:

Concentration of milk of lime, g/l…………………........….. 100-140

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NO:NO2 ratio, mol……………………………..............…… (70-90):30-10)
The duration of irrigation of nitrous gases, minutes 30
Temperature in the absorption tower, 0C…………….…… 30-40
The concentration of the circulating solution of nitrite - calcium nitrate, %...
25-40
Temperature in the evaporator, 0C..........………………… 1200C
Temperature in the mold, 0C………………...............…….. 25
Temperature during drying of wet calcium nitrite in a drum dryer, 0C………………………………..................…………
100-110

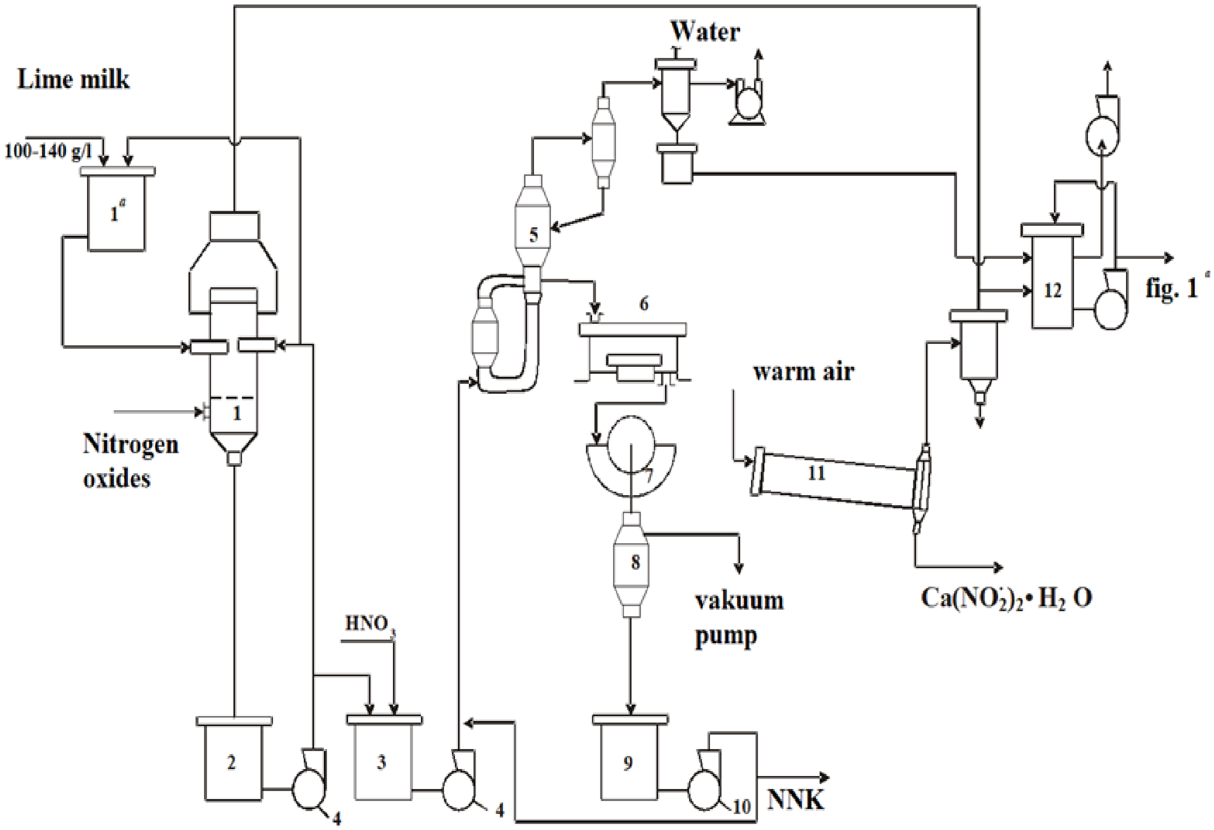

Fig. 1. Technological scheme for obtaining calcium nitrite
1 - Absorption tower, 1a - Filling tanks. 2,3,9 - Mixers. 4,10 - Centrifugal pumps. 5 - Redeemed apparatus. 6 - Crystallizer. 7 - Drum vacuum filter. 8 - Receiver. 11 - Drum dryer. 12 - Scrubber.

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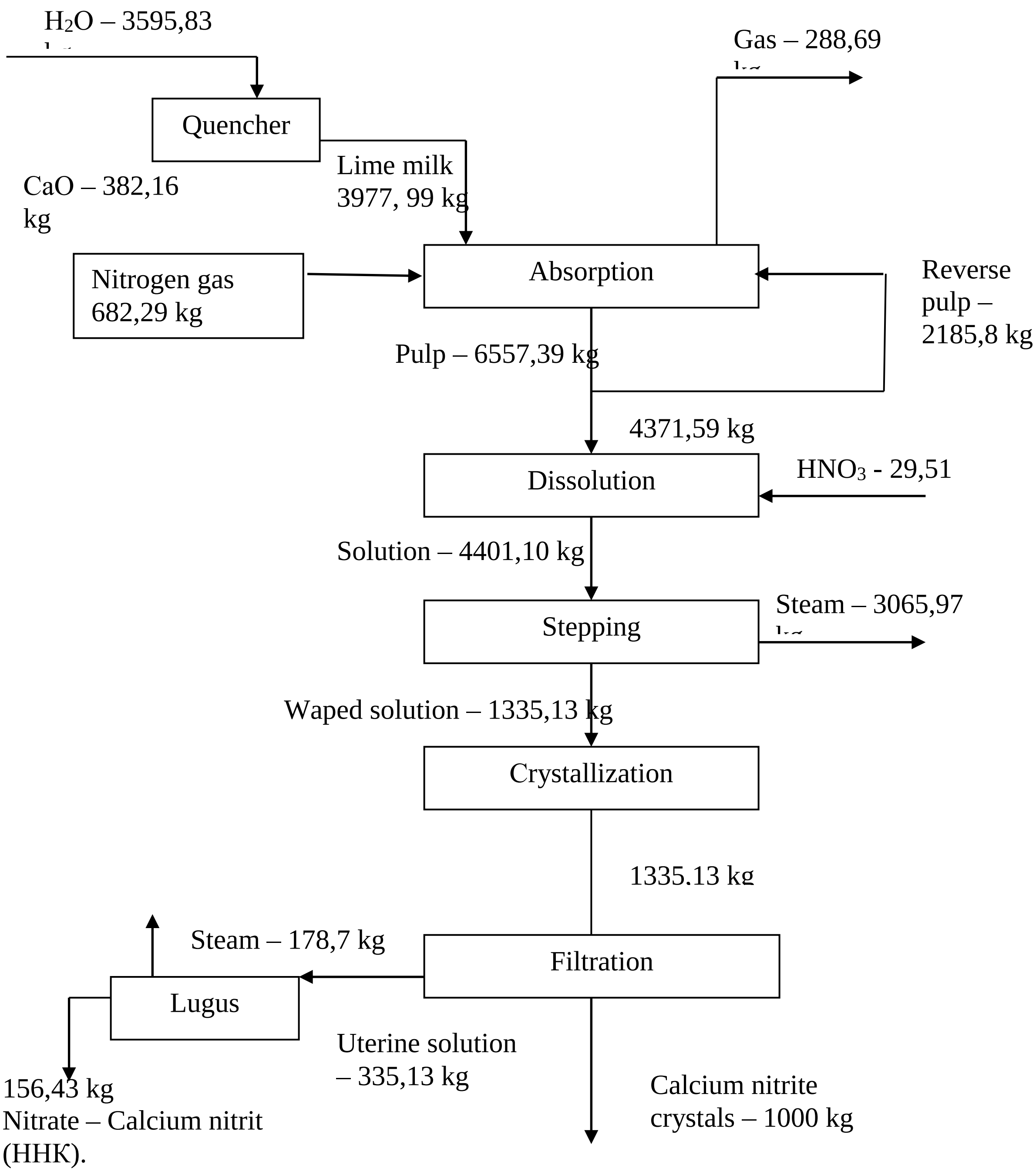

Fig. 2. Material balance of obtaining calcium nitrite.

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