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Development of a Technology for Producing Calcium Peroxide by Converting Calcium Nitrate with Hydrogen Peroxide in the Presence of Ammonia

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ABSTRACT: The optimal conditions for the production of calcium peroxide by the conversion of calcium nitrate with hydrogen peroxide in the presence of ammonia have been determined. The results obtained served as the basis for the development of the technological scheme and the compilation of the material balance for the production of calcium peroxide. The physicochemical properties of the obtained product have been studied.

KEYWORDS:calcium peroxide, conversion, calcium nitrate, enrichment, suspension, evaporation of solutions, physicochemical properties.

I. INTRODUCTION

As shown by many years of scientific and applied research by scientists from different countries, the most popular methods at present to ensure the production of high-purity calcium peroxide and implementation in industry are methods based on the conversion reactions - interaction of calcium salt solutions with hydrogen peroxide in an ammonia or alkaline medium [1–8]. Research on the production of calcium peroxide [9-10] using nitrate and calcium chloride, which is a waste product of soda ash production and was previously used in our research to enrich phosphate materials [11, 12].

II. SIGNIFICANCE OF THE SYSTEM

The optimal conditions for the production of calcium peroxide by the conversion of calcium nitrate with hydrogen peroxide in the presence of ammonia have been determined.The study of literature survey is presented in section III, methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and conclusion.

III. METHODOLOGY

As starting materials, we used a 10% solution of calcium nitrate formed during the enrichment of high-carbonate phosphorite of the Central KyzylKum Mountains according to the technology developed by the Tashkent Chemical-Technological Institute [12].The calcium nitrate solution was evaporated to a concentration of 30% before use, and then the solid phase consisting of dicalcium phosphate and aluminosilicates was filtered off..

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IV. EXPERIMENTAL RESULTS

Also, a 40% hydrogen peroxide solution and gaseous ammonia were used as starting materials. Table 1 shows examples of the implementation of the proposed method and the optimal reaction conditions.

Table 1

Influence of technological parameters on the yield of calcium peroxide.

№ Experiment	Concentration% and consumption (g) solutions			pH	Reaction temperature, ^{0}C	Solid phase, g	Humidity, %	Ratio W: T	Filtration rate, kg/m^2 hour solid/liquid phase	Active oxygen conten, %	exit, %
	$Ca(NO_3)_23$ 0%	H_2O_2 40%	NH_3 25%								
1	14,40	2.61	92,1	9,5	10	2,2	46,8	48:1	113,2 5444	13,81	68,74
2	14,40	2.61	96,2	11	10	2,2	42,3	49:1	41,5 2037,74	14,72	73,27
3	14,40	2.61	2	9	10	2,4	57,1	7,58:1	271,69 2060,38	12,01	65,22

Based on the results of the research, a technological scheme for the production of calcium peroxide based on a weak solution of calcium nitrate, formed during the nitric acid enrichment of low-grade phosphorites of the Central KyzylKum, is proposed. The technology consists of the following stages (Fig. 1): 1. Evaporation of weak solutions of calcium nitrate.2. Condensation of juice steam with circulating water.3. Filtration of a suspension consisting of a calcium nitrate solution and a water-insoluble phase.4. Conversion of calcium nitrate with hydrogen peroxide in the presence of ammonia. 5. Crystallization, separation and drying of calcium peroxide. 6. Evaporation of hydrogen peroxide with circulation of condensate at the beginning of the process and obtaining a concentrated solution of ammonium nitrate. 7. Packing of the obtained products of sodium chloride, ammonium and calcium peroxide. In accordance with the developed technological scheme, a weak solution of calcium nitrate from the well of the filtration section enters the evaporator (item 1), where the stripping is carried out with natural gas at a temperature of 100-120 °C under vacuum. The released water vapor enters the lower part of the condensation column, where it is cooled by circulating water coming from the collector and sent to the cooling unit. A certain part of the condensate is collected in the lower part of the condensation column and is sent to flush the filtered sediments in pos. 2. At stripping, a suspension is formed, consisting of solutions of calcium nitrate and sludge. To separate the sludge, the suspension enters the centrifuge (item 2). The clarified solution from pos. 2 enters the pressure tank (item 3), from where it is sent to the conversion reactor (item 4), where hydrogen peroxide (item 5) and ammonia water or gaseous ammonia (item 6) are fed simultaneously. The resulting suspension is fed to the centrifuge (item 7). The separated wet crystals of $CaO_2 \cdot 8H_2O$ are fed for drying (item 8) to obtain the finished product of calcium peroxide. The mother liquor enters the collector (item 9), from where it is pumped to the evaporator (item 11) using a centrifugal pump (item 10). The vapor phase after condensation in the condenser (item 12) enters the collector (item 13). The resulting weak hydrogen peroxide solution from the collector (item 13) is pumped into a concentrated hydrogen peroxide diluent (item 5) using a centrifugal pump (item 14). The cooled liquid phase, consisting of ammonium nitrate and hydrogen peroxide and calcium through the cooler (item 15) enters the solvent (item 16) where carbamide and / or other nitrogen-, potassium- and phosphorus-containing soluble salts are added to obtain NP-, NK - and NPK - fertilizers

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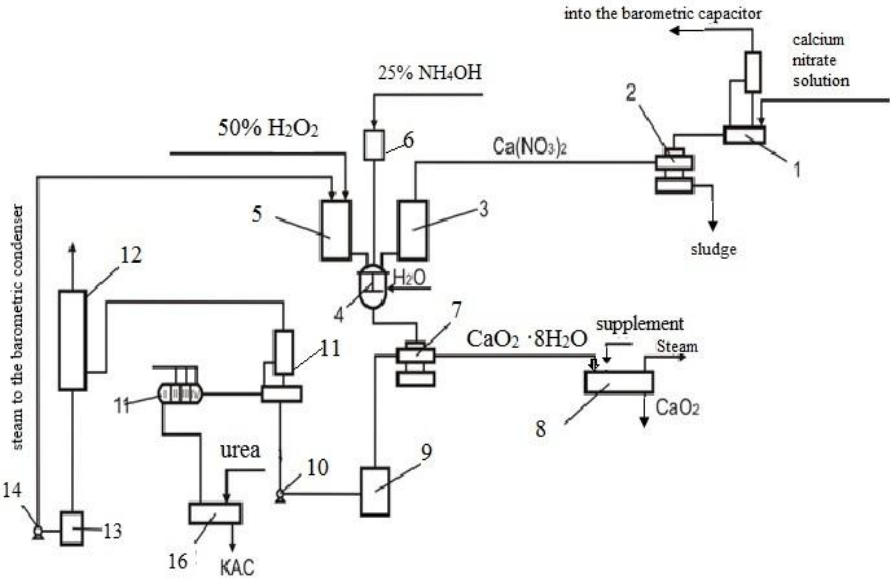

Fig. 1 Process flow diagram of calcium peroxide production based on weak solutions of calcium nitrate.

The advantage of the proposed technology is: in the production of calcium peroxide from a large-tonnage waste-calcium nitrate, which can be formed during the enrichment of low-grade phosphorites of the Central KyzylKum.

Table 2

Physical and mechanical properties of raw materials and products

Technical Indicators	Technical specifications	
	Calcium nitrate	Calcium peroxide
Initial moisture,%	0,024	0,012
Bulk density, g/cm^3	1,0924	0,4546
Density with seal	1,2038	0,6064
Inclination angle, degrees.	26	38
Looseness, sec.	7,5 сек	Not liquid550 сек
Hygroscopic point, %	45%	57%
Stabilizes after 4 hours Moisture capacity, %	50%-0,1%85%-0,4%	50%-0,04% 85%-0,08%
pH 10% suspension	5,52	12,35

Table 2 shows the physical and mechanical properties of the resulting products. The table shows that the free and compacted density of the product is equal to 0,455 and 0,608 g / cm3, respectively, the pH of a 10% suspension is 12,35.

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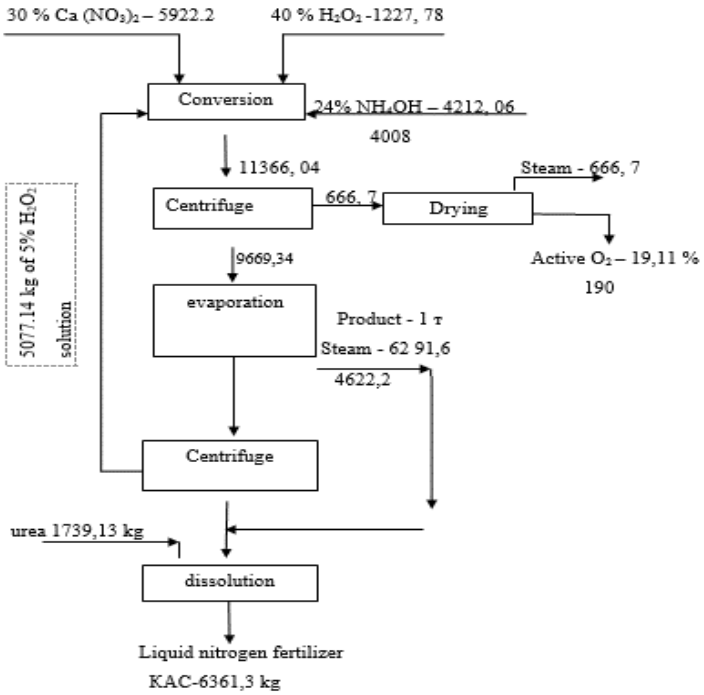

Figure 2.Quantity (kg) of consumables for obtaining 1 ton of $CaO_2$from calcium nitrate solutions.

The basic properties of calcium peroxide have been studied, the material balance has been compiled, and a basic technological scheme for the production of calcium peroxide has been proposed.

V. CONCLUSION AND FUTURE WORK

The conducted studies of the process of obtaining calcium peroxide by the conversion of calcium nitrate with hydrogen peroxide in the presence of ammonia showed that the optimal conditions for the maximum yield of the product (73,27%) are the concentrations of calcium nitrate, hydrogen peroxide and ammonia -30.40 and 25% ratio of L: T-49 :1. The conceptual technological scheme is proposed and the material balance of the process is drawn up. To obtain 1 ton of product, you need to spend 5922,2; 1227,78 and 4212,06 kg of $Ca(NO_3)_2$, H_2O_2 and NH_3, respectively. The main physicochemical properties of the obtained calcium peroxide were determined: bulk density – 0,4546 g/cm^3, density with compaction – 0,6064 g/cm^3, flowability - 550 sec, hygroscopic point - 57%, stabilization time - 4 hours.

REFERENCES

[1]. Volnov, I.I. Peroxides, superoxides and ozonides of alkali and alkaline earth metals. Moscow: Nauka, 1964.143 p.
[2]. Volnov I.I. Peroxide compounds of alkaline earth metals.Moscow: Nauka, 1983.135 p.
[3]. Pat. 2259344 RF, IPC C 06 B 33/12. Ignition composition for solid oxygen sources / KopytovYu.F., Ulyanova MA; FSUE "TambovNIHI". 2005.
[4]. Pat. 2056341 RF, IPC C 01 B 13/02. Pyrotechnic composition for oxygen production / Sinelnikov S.M., Razumova A.P., Sasnovskaya V.D., KlyucharevV.V .; TIHP RAS. 1996.
[5]. Pat.2052283 RF, IPC B 01 J 7/00, C 01 B 13/02. Pyrochemical oxygen generator / Sasnovskaya V.D., Razumova A.P., Aleshin V.V., Klyucharev V.V., Sinelnikov S.M., Logunov A.T., Smirnov I.A., Shibkov V.G. .; TIHP RAS. 1996.
[6]. Pat.8283004 JP, IPC A 62 D 9/00, C 01 B 13/02. Oxygen generator / Nishii Shigeki,Asai Yukio; Daicel Chem. 1996.
[7]. Pat. 2008137880 JP, IPC C 06 B 33/00, C 06 B 43/00. Gunpowdercomposition for launching shooting-up fireworks / Fukui H., HatanakaS .; Rokkusu Japan KK., Kawai Sekkai KK. 2008.
[8]. Pat. 54020987 JP, IPC C 01 B 13/02. Oxygen generating capsule / MonmaKimimichi. 1979.
[9]. Pat.2434063 RF, IPC C 22 B 11/02, G 01 N 33/20. Method for determining gold in ores and concentrates / Lobanov V.G., Vikulov V.I., NabiullinF.M .; FGAOUVPO. 2011.
[10]. Pat. 860001093 KR, IPC C 10 L 9/10.Solid fuel / Kim Su-Hui. 1986.
[11]. Pat.4072169 JP, IPC A 47 J 36/30, B 65 D 81/34. Container with exothermic function / Hayashida Y., Sato Shunichi; Asahi Chem. Ind. 1992.[12]. Pat. 7081986 JP, IPC C 04 B 28/08, C 04 B 5/06. Decoloring and usage of blast furnace water granulated slag and blast furnace cement composition / HanadaMitsuo. 1995..Burmistrova O.A., KarapetyantsM.Kh., Karetnikov G.S. and other Workshop on physical chemistry. / M .: Higher school., 1974 . 496 p.