Physico-chemical nanomaterials science

Obtaining of the modified NH_4NO_3 granules with 3-D nanoporous structure: impact of humidifier type on the granule's structure

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Ammonium nitrate with advanced porous surface, so-called porous ammonium nitrate (PAN), is a necessary component of simplest industrial explosives. A promising method of PAN producing is combination of heat treatment method and hydration of granules in small vortex granulators [1.2].

Hydrodynamic conditions of continuous and dispersed phases motion in the vortex granulator workspace was in details described in [3,4], the model of moisture removal process from the granule to form a porous surface layer – in studies [5,6].

Results of previous studies [5-7] have shown, that modification of ammonium nitrate granules by humidification and subsequent heat treatment leads to changes in the crystal lattice of samples. The porous surface of granules in this case consists primarily of macropores, the presence of which allows to open access to internal mesopores (which were also formed during the modification process).

The main objective of the work is study of humidifier type impact, and the number of humidification cycles on the surface and internal structure of PAN granules nanopores and its quality indicators (holding and absorption capacity).

As humidifier in research of such variants were used:

- water;
- aqueous urea solution;
- aqueous ammonium nitrate solution;

The granules were exposed to single or multiple humidification and were dried in previously defined [5] optimum thermodynamic conditions.

Analysis of experiments results has shown, that various types of humidifiers can form various kinds of pores after drying according to the classification [8]:

- cracks, chips, cavities - "mechanical" pores;
- channels of various shapes - "modification" pores (micro, meso- and macro-pores).

Some of these pores were formed as a result of thermal stresses and inadequate core strength of initial granule («mechanical» pores), some – directly into granules during the drying process after humidification («modification» pores). Various types of humidifiers also have significant effect on the ratio of values of «mechanical» and «modification» pores.

The obtained results allow to select the optimal humidifier composition, which promotes the formation of significant amount of macro pores on surface and mesopores of near-surface areas.

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