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Peculiarities of zirconium hydroxide microwave drying process

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Kinetics of water and hydrated zirconium hydroxide losses under microwave and convective heating has been investigated. The distinctions in evaporation mechanisms of distilled water and water from hydroxides have been shown to be due to different forms of the thermal energy supply as well as by interaction of water molecules with hydroxide ones. It was established that hydroxide drying rate at the microwave heating exceeds that at traditional drying almost by one decimal order. An equation for the MW-drying duration determination has been proposed.

Проведено исследование кинетики потери массы воды и гидратированого гидроксида циркония при микроволновом и конвекционном нагревах. Показано, что различия в механизмах испарения дистиллированной воды и воды из гидроксидов обусловлены различиями форм подвода тепловой энергии и взаимодействием молекул воды с молекулами гидроксида. Установлено, что скорость сушки гидроксида при микроволновом нагреве почти на порядок превосходит скорость конвекционной сушки. Предложено уравнение для определения длительности микроволновой сушки.

Ceramics is a material answering to the modern science and engineering development level. In particular, zirconia ceramics is used as structural and tool material as well as materials with peculiar functions, e.g. filter, catalytic, transport ones, etc. The best raw material for such ceramics is nanocrystalline ZrO_2 powders alloyed by stabilizing additives, mainly by yttrium.

For producing high-dispersed powders, including zirconia ones, the chemical method of co-precipitation is used widely [1]. But it is not always possible to make use of advantages of this method, because structural elements of different structural level (crystal nanoparticles, aggregates, agglomerates [2]) are formed inevitably when the filtered hydroxide precipitate is subjected to drying, which is an obligatory technological operation. The presence of such structures in finely dispersed powders results in formation of zones with different density and non-uniform distribution of different size pores in ceramics [3]. This decreases considerably the densification rate at sintering and favors as well the formation of structural defects (pores, cracks, etc.) in ceramics that can bring to naught the advantages of nanocrystalline powder using. The kind and size of conglomerates depend on the powder production technology, including the drying method.

Today, microwave (MW) heating is used more and more often for the hydroxide precipitate drying (dehydration) [4, 5]. The MW heating differs in principle from the usual convective method: the thermal energy release occurs directly in the material under heating and both large or small mass are heated inertialess, fast and uniformly over the whole volume. But in spite of all MW heating merits, regularities of the co-precipitation product dehydration under microwave heating have been studied still very