Experimental study of low-temperature gasification of urotropine at different flux of filtering gas with obtaining combustible gaseous products

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The gasification of a solid porous hexamethylenetetramine (urotropine) during the filtration of high-temperature gas through it was experimentally studied. The aim of the work is to experimentally study the gasification of urotropine in a low-temperature gas generator at various values of the incoming gas flow.

Low-temperature gas generators are widely used in fire extinguishing systems, for spinning turbines, in airbags, etc. Depending on the application of the gas generator, various requirements are imposed on it, such as the absence of combustible products, high gas production with a minimum heat of combustion and maximum calorific value of gaseous products [1].

Experimental study was carried out to investigate the gasification of urotropine in a low-temperature solid fuel gas generator under varying inlet gas flows. The nitrogen was used as an inert filtering gas. The inlet gas flow was varied from 0.6 to 1.4 L/s with a step of 0.2 L/s. The initial temperature of inlet gas was equal to 910 K. The temperature at the reactor outlet was measured, and gas-sampling of products were collected. The time of fuel gasification was measured. It was shown that with an increase in the nitrogen flow, the time of urotropine gasification decreases. It has to do with an increase in the intensity of interfacial heat transfer with increasing nitrogen flow. Therefore, an increase in the inlet gas flow results to the decreases of gas generator operating time.

When the flux of incoming nitrogen was increased from 0.6 to 1.4 L/s, the average mass rate of urotropine gasification raised from 0.63 to 1.61 g/s. The fuel gasification rate showed an almost linear increase with a raise in the inlet nitrogen flow. This can be attributed to the higher intensity of interfacial heat exchange resulting from the increased nitrogen flow.

It has been shown that the ratio of mass flows of fuel gasification products and inlet gas does not depend on the value of inlet nitrogen flow. When varying the inlet gas flow from 0.6 to 1.4 L/s, the value of the mass flows ratio is constant and equals approximately 0.9 g/g. It is possible to calculate the calorific value of the gas outgoing from the gasifier by means of ratio of fuel gasification products flow and inlet gas one.

It has been shown that the gaseous products of urotropine gasification consist of nitrogen with small amount of hydrogen and hydrocarbons. The nitrogen in the gaseous products of urotropine gasification comes from the nitrogen cylinder. That is at this temperature (910 K) urotropine not only sublimated, but also decomposed to simpler gaseous products. The decomposition of urotropine molecules into simple substances at this temperature is very slow. The content of simple gaseous products does not exceed 4% vol.

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References

M.V. Salganskaya, A.Yu. Zaichenko, D.N. Podlesniy, et al., *Acta Astronaut.* **2023**, 204, 682.