Abstract to the scientific work:

"Development of the technology of accelerated thermal stabilization of the PAN harness for the production of high-strength carbon fibers"

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The development of technologies for producing carbon fibers from polyacrylonitrile since the mid-1960s has led to a gradual reduction in their cost from $ 500-1000/kg to $ 15-25/kg. At the same time, each time the cost reduction allowed us to open up new, larger-scale applications. To date, the main consumers of carbon fibers and composites based on them are: aviation, space, nuclear, construction industries, as well as shipbuilding, automotive, construction of wind farms, sporting goods, etc.

The outstanding physical and mechanical properties of composite materials explains the high interest in this material of many global high-tech companies. However, in comparison with "classical" structural materials (steels, aluminum alloys, plastics, etc.), the use of carbon composites is extremely limited, due to their high price.

However, the mass automotive industry could potentially become a huge market for carbon fiber consumption. Today, the use of carbon fiber plastics in the automotive industry is limited exclusively to luxury cars or sports cars for participation in various races and competitions. The total consumption of carbon fiber for these purposes does not exceed 11% of global consumption, which at current production volumes is about 10-11 thousand tons per year. However, reducing the cost of carbon fiber to 10 €/kg will lead to an avalanche-like increase in the consumption of carbon fiber in the automotive industry due to its introduction into budget car models.

A reduction in the price of high-strength fibers with a standard modulus of elasticity (σ = 4.0- 4.5 GPa, E = 220- 270 GPa) will increase the share of carbon fiber in elements of civil liners, ships, individual parts and train assemblies.

Realizing this fact, most of the world's major carbon fiber manufacturing companies (Toray, Toho Tennax, Dow Aksa, etc.) are conducting research aimed specifically at reducing the cost of carbon fiber. One of the main directions in this case is the reduction of the thermal stabilization time of polyacrylonitrile (PAN) fibers.

The aim of the study is to develop a technology for producing high-strength carbon fiber (σ = 4.0- 4.5 GPa) with a standard modulus of elasticity (E= 220- 270

GPa) with reduced cost by reducing the thermal stabilization time (no more than 30 minutes) of industrially produced PAN fiber.

To achieve this goal, the following tasks were formulated and solved:

1. The options for cost reduction are analyzed based on the stages of the process used in the production of carbon fiber.

2. The critical parameters of thermal stabilization of the PAN fiber, which must be achieved for subsequent stable carbonation, are determined.

3. The method of separation of processes occurring in parallel on the fiber in the process of thermal stabilization is theoretically justified and practically confirmed.

4. Optimization of the processing temperature conditions was carried out to obtain the required physical and mechanical characteristics in the specified time parameters.

5. An economic assessment of the impact of the developed on the price of carbon fiber production was carried out on the example of the production facilities of JSC "ALABUGA-Fiber".

The object of the study is the technology of obtaining carbon fibers based on polyacrylonitrile, in particular, the stage of thermal stabilization; optimization of individual stages and introduction of new techniques into the technology aimed at accelerating the process of fiber heat treatment.

The subject of the study is the process of oxidative thermal stabilization of the PAN fiber and its modification by separating the cyclization and dehydrogenation processes occurring on the fiber surface, accumulation of the intermediate product of the PAN stabilization reaction in the fiber volume with subsequent activation of the process according to the law of effective concentrations, which should increase the rate of obtaining a stable PAN fiber.

The result of the work is the technology of accelerated thermal stabilization of carbon fibers developed and ready for scaling to the industrial level. The results obtained confirm the preservation of the high quality of the obtained fiber while reducing the processing time by 3 times. Such a change in operating time can significantly reduce the cost of carbon fiber production and meet the industry's need for a cheap and high-quality product.