INVESTIGATION OF THE PHYSICOCHEMICAL AND STRUCTURAL PROPERTIES OF TU-90 GRADE CARBON BLACK BASED ON ASTM STANDARDS

Ortiqov Nosir Tojimurodovich

Tashkent Research Institute of Chemical Technology, PhD, Senior Researcher

Karimov Masud Ubaydulla ugli

Deputy Director for Scientific Affairs, Doctor of Technical Sciences, Professor

Djalilov Abdulakhat Turapovich

Director of the Tashkent Research Institute of Chemical Technology,

Doctor of Chemical Sciences, Professor, Academician of the Academy of Sciences of Uzbekistan

Abstract: This article investigates the physicochemical and structural properties of TU-90 grade carbon black according to ASTM standards. During the study, the oil absorption number (OAN), compressed oil absorption number (COAN), and iodine adsorption number were determined, and the structural stability and dispersity of the carbon black were evaluated. The obtained results demonstrated that the TU-90 sample possesses a medium-high structural morphology, high mechanical strength, and enhanced abrasion resistance. Analyses carried out according to ASTM D3493 and ASTM D1510 standards scientifically substantiated the possibility of using TU-90 carbon black as an effective reinforcing material in rubber and polymer composites.

Keywords: TU-90, carbon black, structural stability, oil absorption number, compressed oil absorption number, iodine adsorption number, ASTM D3493, ASTM D1510, rubber, polymer composites.

Carbon black is one of the important industrial products obtained mainly through incomplete combustion or thermal decomposition of hydrocarbon raw materials. At present, carbon black is widely used in the production of automobile tires, rubber products, polymer composites, pigments, and electrical engineering materials. Approximately 90% of the carbon black produced worldwide is consumed

by the rubber industry [1]. The main properties of carbon black are determined by particle size, surface area, structure, and adsorption characteristics. According to ASTM D1765, carbon blacks are classified based on their dispersity and structural properties. Highly structured carbon blacks improve the mechanical strength, abrasion resistance, and deformation stability of elastomeric materials [2].

In recent years, the use of local raw materials for carbon black production has become one of the most relevant scientific directions. Researchers are investigating the possibility of obtaining carbon black from petroleum residues, pyrolysis products, natural gas, and heavy hydrocarbon fractions. Such an approach enables import substitution and increases economic efficiency [3]. The oil absorption number (OAN) is considered one of the most important parameters for evaluating the structural properties of carbon black. According to ASTM D2414, this parameter characterizes the branching degree of aggregates and the volume of internal voids [4]. High OAN values indicate a well-developed structure of carbon black aggregates. In addition, the compressed oil absorption number (COAN) determines the stability of aggregates under mechanical pressure. [5]. The iodine adsorption number is widely used to determine the surface activity and dispersity of carbon black. According to ASTM D1510, iodine adsorption is directly related to the specific surface area and microporous structure of carbon black. As particle size decreases, the iodine adsorption value increases [6]. Therefore, this indicator is considered an important parameter for evaluating the reinforcing properties of carbon black. Modern studies pay particular attention to determining the surface area of carbon black using the BET method. This method, based on the Brunauer–Emmett–Teller theory, makes it possible to determine the specific surface area through adsorption processes. BET analysis provides a deeper assessment of the catalytic, adsorption, and reinforcing properties of carbon black.
The analysis of literature sources shows that the quality indicators of carbon black directly depend on production technology, raw material composition, and thermo-oxidative conditions. Therefore, obtaining highly structured and highly dispersed

carbon black from local raw materials is considered a promising scientific and practical direction.

As a result of the conducted studies, TU-90 grade carbon black was obtained and its physicochemical properties were analyzed according to standard methods.

Table 1.

Structural index values of TU-90 carbon black

Sample	OAN sm^3/kg	Structural Index	Structure category
TU-90	**115.6**	**0.45**	Medium structure

The results demonstrated that the TU-90 sample possesses a medium-high structural morphology. Such carbon blacks improve the mechanical strength and abrasion resistance of rubber materials. The structural index is a relative scientific parameter characterizing the branching degree of carbon black aggregates, internal voids, and interaggregate bonding. Further studies were carried out based on the TU-90 sample. According to ASTM D3493 experiments, the compressed oil absorption number of the carbon black samples was determined.

Table 2.

COAN values of the obtained TU-90 sample

Sample	COAN (m^3/kg)	COAN ($sm^3/100$ g)	Structure level
TU-90	0,0801	80.1	Medium-high structure

These values directly characterize the aggregate strength, the stable part of branching, and the structural resistance during processing and manufacturing. The COAN value is always lower than the OAN value determined according to ASTM D2414 because part of the aggregates are destroyed during compression. For the TU-90 sample, the COAN value of 80.1 cm^3/kg was slightly lower than that of TU-5 81.7 cm^3/kg, indicating relatively denser aggregates. However, the difference among

carbon black grades is insignificant, confirming that the obtained TU-90 sample satisfies industrial structural stability requirements. According to industrial practice, COAN values within the range of 75-85 cm^3/kg indicate that carbon black acts as a good reinforcing material in rubber and elastomer systems and maintains structural stability during processing. Therefore, the TU-90 sample fully meets industrial requirements. The iodine adsorption analysis according to ASTM D1510 demonstrated that the iodine adsorption number of the TU-90 sample reached 90.1 g/kg. This indicates a high surface area, smaller primary particle size, and a larger number of active surface centers. These results provide a scientific basis for the application of TU-90 carbon black in rubber products, pigments, and special compositematerials.

Conclusion: The obtained results demonstrated that TU-90 carbon black possesses a medium-high structure and fully satisfies industrial requirements. The OAN and COAN values confirmed its structural resistance and aggregate stability. The high iodine adsorption number indicated a large specific surface area and high dispersity. Therefore, TU-90 carbon black can be considered a promising reinforcing material for rubber and polymer composite applications.

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