JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 06, June 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

ANALYSIS OF THE STRUCTURAL AND COMPOSITIONAL PROPERTIES OF RICE HUSK

Djurayev Khayrullo Fayziyevich
Doctor of Technical Sciences, Professor, Bukhara state technical university
Gafurov Karim Khakimovich
Doctor of Technical Sciences (DSc), Professor, Bukhara state technical university
Sayilkhonov Khudoyor Narzullo ugli
PhD student, Assistant, Bukhara state technical university

Abstract: This article presents a scientific analysis of the influence of the physical and chemical properties of rice husk, derived from locally cultivated rice varieties, on the separation process. During the research, the density, size, moisture content, and silica composition of the husk from several rice varieties were determined, and their impact on separation technology was assessed. The results show that husks with higher density and greater silica content require high-velocity airflow or vibration-based separation methods. The article provides formulas, physical models, and technological parameters aimed at increasing separation efficiency based on the morphological characteristics of the husk. It is also substantiated that universal machines are not suitable for all varieties, and the development of combined and automated separation systems is essential. The research findings offer practical recommendations for optimizing rice cleaning technologies and improving the design of relevant equipment.

Keywords: rice varieties, husk properties, silica content, density, air separation, cereal crops, morphological analysis, differential velocity.

Introduction. Rice cultivation and its primary processing hold significant importance in grain crop technologies. The outer shell of the grain—the husk—is the main fraction to be separated during rice cleaning, and its physical and chemical properties directly affect process efficiency. Rice varieties differ considerably in their biological traits and adaptation to agro-climatic conditions. Specifically, their husk varies in density, moisture content, silica percentage, shape, and size, all of which are critical in determining the technological mode of the cleaning process.

The husk composition and characteristics of rice varieties grown in local agro-climatic conditions reflect the specific traits of each variety. For example, some varieties have brittle and lightweight husks, making them well-suited for air-based separation, while others are covered with a hard and dense husk, requiring vibrational or mechanical cleaning methods. A high percentage of silica in the husk composition increases dust generation during processing, raising the demands on aspiration systems.

Improving cleaning equipment and processes requires a deep understanding of the physical and chemical properties of rice husk, a thorough assessment of current technological solutions, and the development of new technologies. This study is based on such an approach—identifying differences in husk properties among various rice varieties and evaluating their effect on cleaning technology to justify effective separation methods.

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 06, June 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

Literature Review. Initial processing of rice, particularly husk separation, is a critical stage in agrotechnology. Various sources contain studies on the morphological and physicochemical structure of rice grains. However, in-depth research on the husk characteristics of rice varieties grown under local agro-climatic conditions remains limited.

The outer shell of cereal crops is classified by density, surface temperature, and silica (SiO_2) content. The density of rice husk typically ranges from 90 to 150 kg/m³. This range enables fractional separation by differential velocity in air-separation systems, as described by the following physical formula:

$$F_a = \frac{1}{2} C_d \cdot \rho \cdot A \cdot v^2$$

Where: F_a – air resistance force (N), C_d – drag coefficient (0.3–0.5), ρ – air density (1.2 kg/m³), A – cross-sectional area of the husk (m²), v^2– air velocity (m/s).

Experiments show that rice husk separation in airflow occurs within the range of 1.5–2.5 m/s. For denser varieties (e.g., “Guliston” and “Zarafshan”), this value must exceed 2.3 m/s. According to analyses of mechanical sorting equipment, vibrational surfaces improve separation efficiency by 15–20% when dealing with harder husks. The efficiency of vibrational separation is calculated as follows:

$$\eta = \frac{Q_{toza}}{Q_{umumiy}} \cdot 100\%$$

Where:: η – cleaning efficiency (%), Q_{toza}– mass of correctly separated husk (kg), Q_{umumiy} – total husk mass (kg).

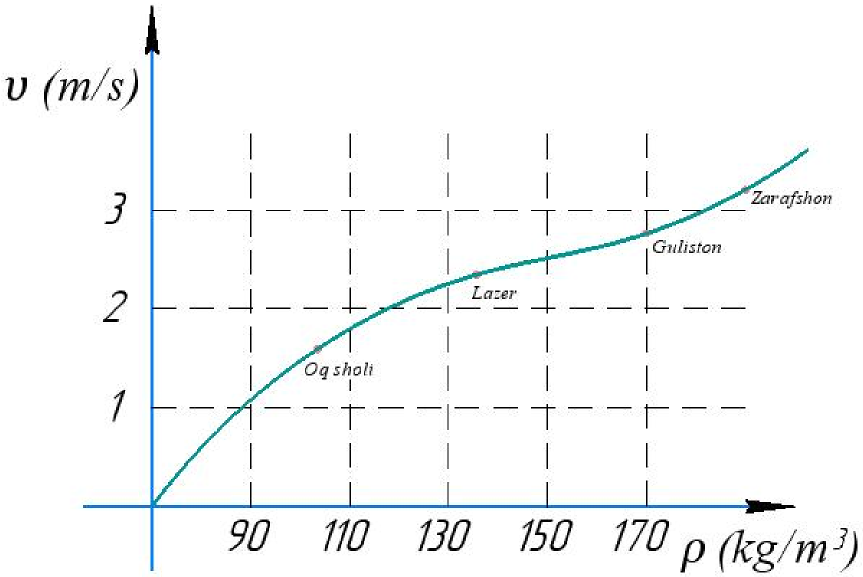
Local studies indicate that when silica content exceeds 18%, dust concentration in the aspiration system surpasses acceptable limits. For instance, the husk of the Zarafshan variety contains 20.3% silica, and without dust filters, concentrations above 1.5 mg/m³ were recorded. Additionally, literature notes that husk size distribution is a key factor in ensuring technological compatibility. The following table compares husk parameters for different varieties:

Variety	Average Size (mm)	Silica (%)	Density (kg/m³)	Moisture (%)
Lazer	5.5	17.2	130	10.5
Oq sholi	6.0	14.6	95	12.0
Guliston	4.5	19.1	150	9.2
Zarafshon	4.0	20.3	145	8.0

Table 1. Characteristics of rice husk by variety

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 06, June 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

The correlation between the air separation velocity and the husk density for each rice variety is



presented in the graph below.

Figure 1. Relationship between air separation velocity and husk density

This graph demonstrates that varieties with higher husk density require greater air velocity for separation, which in turn increases the technical requirements for equipment design.

Many international sources (e.g., Rao & Raju, 2015) also highlight that husk morphology significantly affects separation equipment. However, those studies focus on tropical varieties and do not consider local agro-climatic conditions. Therefore, this study prioritizes technological approaches based on the specific properties of locally grown varieties.

Discussion. The results of the study show that rice varieties grown under local agro-climatic conditions differ in their suitability for separation technologies due to their morphological and physicochemical characteristics. In particular, the density and silica content of the husk have a direct effect on the efficiency of the separation process. It was determined that the density of rice husk ranges from 90 to 150 kg/m³, and silica content ranges from 14.6% to 20.3%, which necessitates adjusting the operating parameters of separation equipment accordingly.

The effectiveness of the separation process primarily depends on the aerodynamic behavior of the husk in airflow, which is described by the formula for air resistance force. Based on experimental data, it was found that for denser varieties (such as Guliston and Zarafshan), the airflow velocity must exceed 2.3 m/s to achieve optimal separation efficiency. This requires improvements in equipment design, particularly in ventilation and filtration systems. Moreover, a comparison of vibrational and mechanical separation methods shows that lightweight and thin husk (typical of the Oq Sholi variety) is more efficiently separated through airflow, resulting in

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 06, June 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

reduced energy consumption and lower dust generation. However, for dense and hard husk types (like Guliston and Zarafshan), effective separation cannot be achieved without vibrational agitation elements.

The analysis indicates that the physical and chemical parameters of rice husk—especially density, size, shape, and silica content—are critical factors in selecting an appropriate cleaning technology. Equipment that does not account for these parameters may suffer from a 20–25% reduction in performance. Therefore, it is essential to adapt the separation process to each rice variety's characteristics by selecting an appropriate operating mode and control system.

The discussion confirms that no single type of equipment is universally suitable for all rice varieties. This necessitates the development of combined systems—such as hybrid air and vibration-based separation technologies. Furthermore, the implementation of automatic sensor-based monitoring systems, capable of adjusting air pressure in response to husk density, will contribute to process optimization. Overall, the husk properties of different rice varieties call for a reconsideration of cleaning technology not only from a design perspective but also in terms of energy efficiency and environmental impact. These findings justify the need for resource-efficient, high-precision, and automated solutions in rice processing.

Conclusion. The results of the study confirm that the husk properties of rice varieties grown in local agro-climatic conditions are distinct, and their physicochemical characteristics have a direct influence on the efficiency of separation technology. Factors such as husk density, silica content, shape, and moisture level must be considered when determining the technological parameters of the separation process. For example, lightweight husk is best separated by air, while dense and silica-rich husk varieties require vibrational or mechanical systems.

Based on the obtained data, it is recommended to develop customized, combined, and automated equipment rather than relying on universal solutions. To improve the efficiency of the separation process, it is necessary to optimize airflow velocity, the design of sorting platforms, and the energy efficiency of the equipment. The findings of this study provide a practical basis for modernizing rice cleaning technology, enhancing the performance of agricultural machinery, and promoting waste-free processing systems.

References.

1.Matismailov, S.L., & Pirmatov, A.P. (2017). Technology of screening and cleaning. – Tashkent: "Science and Technology", 216 pp.
2.Abdurahmonov, A.A. (2020). Physicochemical composition of rice husks and their processing technologies. // Agricultural Machinery, No. 2, pp. 45–50.
3.Bekchanov, M.T. (2019). Increasing rice yield through agrotechnical measures. // Agrarian Scientific Journal, No. 3, pp. 30–34.
4.Rao, P. & Raju, D.V. (2015). Rice Husk Utilization in Modern Processing Plants. – Delhi: Agrotech Publishing, pp. 102–118.
5.Ismoilov, I.Kh. (2021). Technological quality indicators of local rice varieties. // Technological Research, No. 4, pp. 55–60.

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 06, June 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

6.Juraev, D.R. (2022). Evaluation of the efficiency of rice grain cleaning and sorting methods. // Bulletin of Technical Sciences of Uzbekistan, No. 1(65), pp. 40–47.
7.Xu, Y., & Zhang, L. (2018). Study on Physical Properties of Rice Husk and Its Separation Efficiency. // International Journal of Agricultural Engineering, Vol. 10(3), pp. 275–281.