Investigation Of Efficiency In Granulation Device

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ABSTRACT

This article presents the results of an experiment aimed at improving the efficiency of the granulation process. The study evaluates the impact of one of the key parameters of the granulation device-the number of rollers and the installation angle of the blade-on the quality and physical properties of granules. The results show that an increase in the number of rollers improves the uniformity of granule length and reduces disintegration. The optimal blade angle contributes positively to the stability and strength of granules. The best results were achieved at a 180° angle and with three rollers. This research provides a scientific basis for improving granulation technology and increasing efficiency in industrial production processes.

Keywords: granulation, granulation technology, efficiency, quality, logistics, digestion, transport, technological parameters, storage, stability, dust formation, quality loss.

Introduction. In modern food and feed industries, the granulation process plays an important role in improving product quality and reducing logistics costs. Granulation technology is widely used in the production of high-quality feed for livestock, as well as in the chemical and pharmaceutical industries. Granulated products are more stable during transportation and storage, reducing dust formation and degradation. Moreover, the granulation method helps preserve the nutritional value of the product and enhances its digestibility [1-5].

The granulation process increases the density of feed products, improving their water absorption and biological digestibility. This is particularly important for enhancing the efficiency of feed utilization in livestock farming. Additionally, granulated feed occupies less volume during transport and storage, providing economic benefits. Optimizing the granulation process can enhance production efficiency and reduce product costs [6-9].

Determining the optimal technological parameters for the granulation process has both scientific and practical significance. In particular, studies on the impact of the number of rollers and blade installation angle on granule quality and production efficiency are crucial. This article examines these parameters to determine the most favorable conditions for optimizing the manufacturing process [10-12].

Material and Methods. The study evaluated the operation of the granulation device under different parameters. The experiment focused on two main factors: the number of rollers (1, 2, and 3) and the blade installation angle (160°, 170°, 180°, and 190°). Granule length

uniformity and disintegration were the primary assessment criteria.

Experiments were conducted in a controlled laboratory environment with stable temperature and humidity. The feedstock was prepared with a uniform composition, and separate trials were conducted for each parameter. The granulation device was technically adapted for testing, and measurements were repeated multiple times to ensure accuracy and reproducibility.

The evaluation process included:

- **Granule length uniformity** – measured using specialized equipment and recorded as a percentage.
- **Granule disintegration rate** – assessed using sieving methods and calculated as a percentage of disintegrated fractions.
- **Microscopic analysis** – conducted using a scanning microscope to examine granule composition and structure.
- **Moisture content** – determined by storing the product in an extremely low-humidity environment.

Statistical analysis and comparison methods were used to interpret the data. The most effective conditions for each parameter were identified, and their interrelationships were evaluated.

Results.

Figure 1. The developed mini granulator.

Effect of number of rollers. The study showed that as the number of rollers increased, granule length uniformity improved (from 78.6% to 84.1%). This result indicates that additional rollers enhance granule distribution and maintain a consistent size. Furthermore, granule disintegration decreased as the number of rollers increased (from 5.3% to 3.6%), confirming improved mechanical strength.

Number of Rollers	Granule Length Uniformity (%)	Granule Disintegration (%)	Moisture Content (%)	Mechanical Strength (MPa)
1	78.6	5.3	12.1	2.5
2	82.5	4.1	11.8	2.9
3	84.1	3.6	11.5	3.2

Effect of blade installation angle. When evaluating the effect of the blade installation angle, it was found that increasing the angle improved granule uniformity (from 78.3% to 82.9%), with the best result observed at 190°. However, granule disintegration decreased up to 180° (from 6.2% to 4.1%) but slightly increased at 190° (5.9%), suggesting that an excessive cutting angle might negatively impact granule hardness. Mechanical strength analysis showed that a 180° angle ensured optimal granule density and durability.

Blade Angle (°)	Granule Length Uniformity (%)	Granule Disintegration (%)	Moisture Content (%)	Mechanical Strength (MPa)
160	78.3	6.2	12.3	2.4
170	79.7	5.6	12.0	2.6
180	81.5	4.1	11.6	3.0
190	82.9	5.9	11.7	2.8

Figure 2. Granules obtained from the experiment.

Conclusion. The research results indicate that increasing the number of rollers and optimizing the blade installation angle significantly improves granule quality, stability, and strength. The best results were achieved with three rollers and a 180° blade angle. Based on the findings, the following conclusions were drawn:

- ✓ Increasing the number of rollers enhances granule quality and stability.
- ✓ An optimal blade installation angle (180°) ensures the best granule formation.
- ✓ Granule mechanical strength improves under optimal parameters, making them more durable during transportation and storage.
- ✓ Reducing moisture content is crucial for storage longevity and quality preservation, with the best results observed at 180° and three rollers.
- ✓ Precise control of technological parameters is essential for increasing production efficiency.

The analysis confirms that selecting optimal technological parameters not only improves product quality but also enables efficient resource utilization in the manufacturing process. Improving the granulation process also enhances economic efficiency, energy savings, and production sustainability. These research findings provide a crucial scientific basis for future studies aimed at increasing the efficiency of the granulation process.

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