

# Granulometric Composition and Dimensional and Mass Parameters of Granular Feed Distributed to Fish

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**Abstract:** When developing a fish feed distribution device and justifying the parameters of the working parts of the feed distributor, including the centrifugal feed distribution disc, with uniform distribution of granular feed within the established requirements for fish ponds, it is important to know the granulometric composition and dimensional and mass parameters of granular feed. Granular feeds contain a relatively large number of fractions larger than 15 mm. The number of these fractions averages 21.0%, their mean square deviation is 3.54%, and the coefficient of variation is 16.86%. In granular feeds, the smallest amount was fractions within 5-10 mm in length, and their number averaged 10.2% of the total amount of feed. The average square deviation of the amount of feed of this size was 1.92%, and the coefficient of variation was 18.82%. This condition means that granules of 5 to 10 mm in size will have similar dimensions, while granules of 10 to 15 mm in size and fractions of more than 15 mm in size will have relatively large size differences from each other.

## 1 INTRODUCTION

The design features of the device when developing a device for spreading granular feed into fish ponds are that in order to study the technological process of the device and substantiate the parameters of the feed spreader, it is necessary to study some physical and mechanical properties of granular feed as a handout.

A number of researchers such as V. A. Murovanny, M. A. Zaitseva, V. V. Lavrovsky, V. F. Nekrasivich, A. N. Chipinova, B. T. Sariev, A. T. Lebedev, T. Condo, K. Mizuno, T. Kato, M. Mohsenin, D. M. McRandal, P. B. McNulty, V. M. Sonde, P. N. Belkhode, C. N. Sakhole, A. M. Shal, Z. Ghorbani, Y. Jekendra, A. Kumar conducted scientific research in the field of studying the physico-mechanical properties of granular feeds (Sattarov et al., 2020; Djiyanov et al., 2024).

In Uzbekistan, a number of researchers have also been engaged in determining the physical and mechanical properties of feed. Including I. I. Khalilov, B. G. Kamilov, D. Niyazov, G. M. Saifullaev, H. Gafforov, D. S. Gusenov, K. D. Astanakulov, F. U. Karshiev, B. A. Khotamov, A. N. Barotov, Sh. H. Gapparov, etc. scientific research was conducted to study the physico-mechanical and

morphological properties of fish feeds, in the form of granules and green mass (Isakova et al., 2024; Astanakulov et al., 2023).

In scientific studies conducted by the above-mentioned scientists, the physico-mechanical properties of granular feed were studied, in which the physico-mechanical properties of granular feed in terms of dispersion and volatility were not studied comprehensively enough. In our republic, when feeding fish, along with the green mass, they are also fed with granular feed.

On fish farms, when spreading granular feed into a fish pond, they must scatter granular feed of a certain size and in the same quantities, taking into account the specifics of the design of the new device that does this, as well as the fact that the device must distribute them all with the same quality, despite the fact that different granular feeds are distributed in the dispenser. It will study the physical and mechanical properties of feed.

It is also important to know the granulometric composition and dimensional and mass parameters of granular feed when developing a fish feed distribution device and justifying the parameters of the working parts of the feed distributor, including the centrifugal feed distribution disk, with uniform distribution of

granular feed within the established requirements for fish ponds.

## 2 MATERIALS AND METHODS

Experiments to determine the physical and mechanical properties of granular feed were carried out on the basis of the methods set out in the normative documents GOST 20915-2011 "Agricultural machinery. Methods for determining test conditions" and "physical properties of plant and animal materials" (Alijanov et al., 2020; Orlov and Richagov, 1985).

The proposed research program mainly included the determination of the average length, diameter, weight and composition of granular feeds, as well as the ratio of their constituent components, density, angle and coefficient of friction and crushing strength.

A ruler, a caliper, an electronic scale, an inclined plane device and an AMF-500 device for determining the crushing resistance force were used as measuring instruments for determining the size and mass parameters of granular feed (Fig.1).

The results obtained in the experiments were processed by mathematical statistics methods and their statistical characteristics were determined, namely: the average value of ( $M_{\text{average}}$ ), the mean square deviation ( $\sigma$ ), the coefficient of variation ( $V$ ), etc.



1- AMF-500 device; 2- Electronic Scale; 3- Caliper; 4- Ruler.

Figure 1: Measuring instruments.

Feeds intended for feeding fish are produced according to certain established standards GOST

28758-97 – "Granular feed for fish" and interstate standards GOST 10385-2014 – "Compound feed for fish" (Orlov and Richagov, 1985; Andrews and Pag, 1975).

The diameter of granular feeds developed for fish according to these standards should be within 2.0-3.5 mm for small fish and from 2.0 mm to 15 mm for fish placed for fattening (fish weighing 50 g and above). It is established that their length should be from 2 to 20 mm, starting with a diameter 2 times larger.

In Uzbekistan, granular feed is mainly used to feed fish, which are supplied for fattening. For Fish supplied for fattening, the diameter of pellets produced in-house and imported from abroad is mainly in the range of 5-6 mm, and the length is in the range from 5 mm to 20 mm.

But in order to determine what the fractional composition of these feeds is, they were divided into 3 groups by length, namely into granular feeds up to 5-10 mm, 10-15 mm and 15-20 mm long.

To improve the accuracy of data on the morphological composition of granules, experiments were carried out on samples of granules prepared in different places by different manufacturers, which were sequentially distributed among fish for 2-3 years (Andrews and Page, 1975; Grayton and Beamish, 1977).

## 3 RESULTS AND DISCUSSION

The experiments were carried out on samples of 1000 g in several revolutions. According to the results of the experiment, it turned out that on average ( $M_{\text{average}}$ ) 68.8% of the composition of granular feeds developed for fish are feeds in the range of 10-15 mm. Their mean square deviation ( $\sigma$ ) is 3.96%, and the coefficient of variation ( $V$ ) is 5.76% (Table 1).

Table 1. Granulometric composition of granular feed distributed to fish.

№	Fraction size	Number of fractions, %		
		$M_{\text{average}}$	$\pm \sigma$	$V, \%$
1	5-10 mm	10,2	1,92	18,82
2	Within 10-15 mm	68,8	3,96	5,76
3	More than 15 mm	21,0	3,54	16,86

Granular feed contains a relatively large number of fractions larger than 15 mm. The number of these fractions averages 21.0%, their mean square

deviation is 3.54%, and the coefficient of variation is 16.86%.

In granular feeds, the smallest amount was fractions within 5-10 mm in length, and their number averaged 10.2% of the total amount of feed. The average square deviation of the amount of feed of this size was 1.92%, and the coefficient of variation was 18.82%.

This condition means that granules of 5 to 10 mm in size will have similar dimensions, while granules of 10 to 15 mm in size and fractions of more than 15 mm in size will have relatively large size differences from each other.

In order to clarify the size and mass parameters of these fractions, the length, diameter and mass of each fraction were determined separately. From the granules of the 5-10 mm fraction, it turned out that with the length of the largest ( $x_{max}$ ) 9.8 mm, and the smallest ( $x_{min}$ ) 5.1 mm, their average length is 8.5

mm, the standard deviation is 1.06 mm, and the coefficient of variation is 12.48% (Table 2).

On the other hand, the diameter of the granules in the 5-10 mm fraction varied between 5.0-5.2 mm, and it was found that they averaged 5.09 mm. Their mean square deviation and coefficient of variation are also insignificant and amount to 0.05 mm and 0.97%, respectively.

The length of granules in granular feeds, the size of which is in the range of 10-15 mm, varies from a minimum of 10.2 mm to a maximum of 14.9 mm, with an average of 13.21 mm. Considering that their mean square deviation is 0.97 mm and the coefficient of variation is 7.32%, this suggests that they do not differ much from each other.

The diameter of the granules in this fraction is also in the range of 5.0-5.2 mm, which averages 5.09 mm, and their difference is very small, the mean square deviation is 0.05 mm, and the coefficient of variation is 0.9 %.

Table 2.:Size and mass indicators of granular fish feed.

№	Granule sizes	Indications	$x_{max}$	$x_{min}$	$M_{average}$	$\sigma$	V, %
1	5-10 mm	length, mm	9,8	5,1	8,50	1,06	12,48
		diameter, mm	5,2	5,0	5,09	0,05	0,97
		weight, gr	0,271	0,159	0,21	0,03	14,03
2	10-15 mm	length, mm	14,9	10,2	13,21	0,97	7,32
		diameter, mm	5,2	5,0	5,09	0,05	0,92
		weight, gr	0,389	0,265	0,32	0,03	8,81
3	15-20 mm	length, mm	20,0	15,2	16,90	1,22	7,25
		diameter, mm	5,2	5,0	5,10	0,06	1,19
		weight, gr	0,479	0,365	0,40	0,03	7,77

This circumstance is explained by the use of matrices of the same diameter in the production of granular feed. The difference in the diameter of the granules is explained by the fact that they expand or contract relatively during the construction process.

The diameter of the granules in the 15-20 mm fraction also varied between 5.0-5.2 mm, their average value was 5.1 mm, and was the same as the diameter of the granules in the 5-10 mm to 10-15 mm fraction.

Within the limits of a 15-20 mm long fraction, the maximum length of the granules was 20.0 mm, and the minimum was 15.2 mm, while their average value was 16.9 mm. With their mean square deviation of 1.22 mm, the coefficient of variation was 7.25 percent. This circumstance indicates that in fractions with a length of 15-20 mm, the length of the granules is mainly in the range of 15.7-18.1 mm, while granules, larger or smaller in size, make up a very small amount.

In the experiments, the mass of granules was also determined by fractions. At the same time, the mass of granules in a fraction with dimensions within 5-10 mm varies between 0.159 - 0.271 g and averages 0.21 g, the mass of granules in a fraction with dimensions within 10-15 mm varies between 0.265 - 0.389 g. The mass of granules in a fraction with dimensions within 15-20 mm varies on average 0.265 g, the mass granules in the range of 0.479 g, which is an average of 0.40 g turned out.

## 4 CONCLUSION

1. As a rule, the mass of granules in a fraction with a size of 10-15 mm is 1.52 times greater than the mass of granules in a fraction with a size of 5-10 mm, whereas the mass of granules in a fraction with a size of 15-20 mm is 1.25 times less.

2. The maximum value of the mass of granules (0.271 g) In a fraction in the range of 5-10 mm, exceeding the minimum value of the mass of granules in the range of 10-15 mm (0.265 g), this condition is observed even in fractions in the range of 10-15 mm and 15-20 mm, which is explained by the fact that each granule also partially differs from each other in density.
3. The difference in the mass of granular feed indicates that they directly affect the uneven distribution during the distribution process, and this must be taken into account when justifying the parameters and operating modes of the feed distributor disk.

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