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STUDY OF PHYSICAL AND MECHANICAL PROPERTIES OF GRANULAR FEEDS DISTRIBUTED TO FISH

Fazliddin Kurbonov
PhD., Associate Professor, Candidate of Technical Sciences,
Tashkent State Agrarian University

Abstract
In a period when fisheries are developing in the world and the demand for fish products is increasing, the use of energy and resource-saving technologies and equipment for fish feeding and feeding is taking one of the leading places. Considering that "around 180 million tons of fish and fish products are produced worldwide, of which 32 percent are raised in ponds" and that granulated feeds are mainly used for feeding them, improving the quality of granulated feed distribution, reducing labor costs and costs, in turn, requires the widespread introduction of high-quality, energy- and resource-saving feed distributors into practice.

Keywords: Granulometric composition, device, granular feeds, technological process, fish ponds, method.

Introduction

In this regard, the widespread introduction of devices that distribute granulated feeds to fish ponds in the same amount as required is of great importance. When developing a device for distributing granular feed into fish ponds, the specific aspects of the device's design are that it is necessary to study some of the physical and mechanical properties of granular feed as the material being distributed in order to study the technological process of the device and justify the parameters of the feed dispenser. In scientific research, the physical and mechanical properties of granular feeds have been studied, but the physical and mechanical properties of granular feeds in terms of scattering and flight have not been studied in a comprehensive manner. In our republic, fish are fed with granular feeds, along with green grasses and granular feeds.

Considering that when distributing granular feeds to fish in water bodies in fish farms, they should be distributed uniformly in a certain size, the specific features

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of the newly developed device design that implements this, and the fact that the device should distribute all of them in the same quality, despite the distribution of different granular feeds in the dispenser, it is necessary to study the physical and mechanical properties of granular feeds, which are the most widely distributed feed.

Materials and Methods

Experiments to determine the physical and mechanical properties of granulated feeds were carried out based on the methods given in the normative documents GOST 20915-2011 "Agricultural equipment. Methods for determining test conditions" and "Physical properties of plant and animal materials".

The planned research program mainly included determining the average length, diameter, 1000 g mass and the ratio of the components of the composition, density, friction angle and coefficient, and crushing resistance of granulated feeds. In determining the dimensional and mass indicators of granulated feeds, a ruler, a caliper, electronic scales, an inclined plane device, and an AMF-500 device were used as measuring instruments (Fig. 1).

The results obtained in the experiments were processed using mathematical statistical methods, and their statistical characteristics, i.e. the average value of the mean, the standard deviation, the coefficient of variation V, etc., were determined.

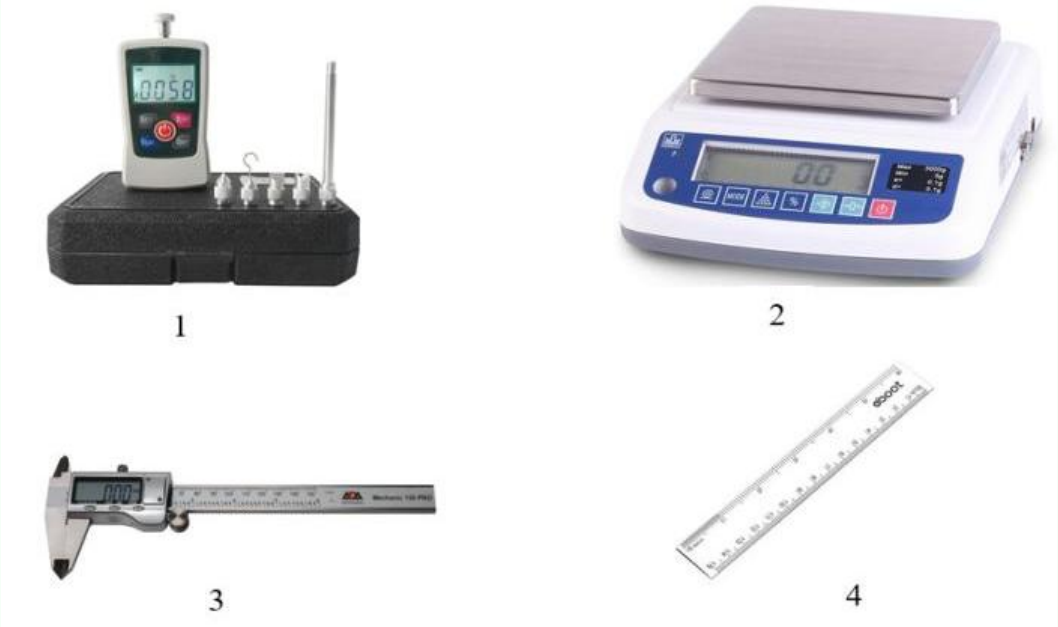

Figure 1. Measuring instruments

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1- AMF-500 device; 2-scale; 3-bar caliper; 4-ruler

Study of the granulometric composition of granular feed distributed to fish

When developing a fish feed distribution device and justifying the parameters of the working parts of the feed distributor, including the centrifugal disc that distributes the feed, it is important to know the granulometric composition and size-weight indicators of granular feed.

Feed intended for feeding fish must meet certain established standards GOST 28758-97 – "granular fish feeds" and GOST 10385-2014 – "fish feed" produced according to international standards.

Method According to these standards, the diameter of pelleted feeds for fish should be 2.0-3.5 mm for small fish, and 2.0 mm to 15 mm for breeding fish (fish weighing 50 g and above). Their length should be 2 times the diameter and up to 20 mm. In Uzbekistan, pelleted feeds are mainly used for feeding breeding fish. The diameter of pellets produced domestically and imported for breeding fish is mainly in the range of 5-6 mm, and the length is from 5 mm to 20 mm.

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

In order to increase the accuracy of data on the morphological composition of the pellets, experiments were carried out on samples of pellets prepared in different places by different manufacturers, which were distributed to fish sequentially for 2-3 years.

Results and their analysis

The experiments were conducted on 1000 g samples in several replicates. According to the results of the experiment, it was found that on average (Fragile) 68.8% of the composition of the granulated feed developed for fish is made up of feeds with a size range of 10-15 mm. Their standard deviation (σ) is 3.96%, and the coefficient of variation (V) is 5.76% (Table 1, 2, 3.).

Table 1. Granulometric composition of the granulated feed distributed to fish

№	Fraction size	Amount of fractions, %		
		$M_{o'rt}$	$\pm\sigma$	V, %
1	5-10 mm	10,2	1,92	18,82
2	Between 10-15 mm	68,8	3,96	5,76
3	Larger than 15 mm	21,0	3,54	16,86

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The granulated feed composition is relatively large in size, consisting of fractions larger than 15 mm. The average amount of these fractions is 21.0 percent, with a standard deviation of 3.54 percent and a coefficient of variation of 16.86 percent.
The smallest amount of granulated feed composition is fractions with a length of 5-10 mm, with an average of 10.2 percent of the total feed. The standard deviation of the amount of feed of this size is 1.92 percent and a coefficient of variation of 18.82 percent.
This means that the size of granules in the 5-10 mm range is close to each other, while the size of granules between the 10-15 mm and the larger than 15 mm fractions is relatively different from each other.
In order to clarify the size-mass indicators of these fractions, the length, diameter and mass of each fraction were determined separately. It was found that the largest (xmax) of the granules in the 5-10 mm fraction had a length of 9.8 mm and the smallest (xmin) was 5.1 mm, with an average length of 8.5 mm, a standard deviation of 1.06 mm, and a coefficient of variation of 12.48 percent (Table 2.2).
The diameter of the granules in the 5-10 mm fraction varied between 5.0-5.2 mm, with an average of 5.09 mm. Their standard deviation and coefficient of variation are also negligible, amounting to 0.05 mm and 0.97 percent.
The length of the granules in the fraction with a size of 10-15 mm in the composition of granulated feed varies from a minimum of 10.2 mm to a maximum of 14.9 mm, with an average of 13.21 mm. Their standard deviation is 0.97 mm, and the coefficient of variation is 7.32 percent, which indicates that their differences are not very large.
The diameter of the granules in this fraction is also in the range of 5.0-5.2 mm, with an average of 5.09 mm, and their differences are very small, with a standard deviation of 0.05 mm, and the coefficient of variation is 0.92 percent.

Table 2. Size-mass indicators of granulated fish feed

№	Granule sizes	Indicators	$x_{max,}$	x_{min}	$M_{o'rt}$	yoσ	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
		mass, 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
		mass, 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
		mass, gr	0,479	0,365	0,40	0,03	7,77

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This is explained by the use of matrices with the same diameter in the production of pelleted feeds. The difference in the diameter of the pellets is explained by their relative expansion or narrowing during their formation.

The diameter of the pellets in the 15-20 mm size fraction also varied within 5.0-5.2 mm, with an average value of 5.1 mm, and was the same as the diameter of the pellets in the 5-10 mm and 10-15 mm size fractions.

In the 15-20 mm length fraction, the maximum length of the pellets was 20.0 mm, and the minimum length was 15.2 mm, with an average value of 16.9 mm. Their standard deviation was 1.22 mm, and the coefficient of variation was 7.25 percent. This 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, and granules larger or smaller than this are very small.

The experiments also determined the mass of granules by fraction. It was found that the mass of granules in the 5-10 mm fraction varied in the range of 0.159 - 0.271 g, averaging 0.21 g, the mass of granules in the 10-15 mm fraction varied in the range of 0.265 - 0.389 g, averaging 0.265 g, and the mass of granules in the 15-20 mm fraction varied in the range of 0.365 - 0.479 g, averaging 0.40 g.

This indicates that the difference in the mass of granulated feeds directly affects their 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.

Table 3. Aerodynamic properties of granulated fish feed

№	Fraction size	Aerodynamic properties of samples	
		critical flight speed, m/s	coefficient of buoyancy, 1/m
1	5-10 mm	4,2 - 6,5	0,23 - 0,55
2	10-15 mm	6,8 - 7,0	0,2 - 0,21
3	15 mm and more	7,2 - 8,8	0,12 - 0,18

It was found that the critical flight speed of granules larger than 15 mm varies in the range of 7.2 - 8.8 m/s, and the sailing coefficient varies in the range of 0.12 - 0.18 m-1 and differs from each other by a factor of 1.5.

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Conclusion

With a diameter of about 5 mm in pelleted feeds produced for fish, on average 68.8% of the feed composition is made up of granules with a size of 10-15 mm, 10.2% are fractions of granules with a size of 5-10 mm, and 21.0% are fractions of granules with a size of 15-20 mm.

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