ABSTRACT

Thesis topic: **“Developm ent of a coulter anchor design for a wide-cut seeder with increased wear resistance”**

In most seeder designs used in Northern Kazakhstan for grain crop cultivation (SZTS-6, SZTS-12, SZS-2.1, “Amazone,” “John Deere,” Massey Ferguson, etc.), seeds and fertilizers are applied simultaneously at the same depth. In other seeder designs, such as the John Deere 1895, TUME, FlexiCoil, Bourgault, HORSCH Sprinter ST, and others, fertilizers and seeds are applied separately to different soil layers. To implement this method, additional coulters are installed, which increases the cost of the seeders and impairs their maneuverability when working on stubble.

Another factor that must be considered when designing the working parts of seed and fertilizer seeders is abrasive wear.

Due to the soil and climatic conditions of Kazakhstan’s grain-growing regions, seeder coulters and their components are subject to severe abrasive wear, so they must be reinforced during manufacturing. As the wear on the working parts increases, the relative unevenness of their penetration depth increases, which leads to an increase in the machine’s traction resistance and, consequently, to an increase in specific fuel consumption. It has been established that the rate of changes in mass, wear volume, and geometric characteristics of the working parts is determined by the combined influence of the cultivated area and the mechanical and physical properties of the soil, which leads to differences in service life before reaching the critical wear threshold. This leads to variations in service life until the point of wear-out. Therefore, improving the wear resistance of the spreader’s absorbent material and its components is a pressing issue.

Research based on scientific articles has shown that modern hardening methods can significantly increase the service life of agricultural machinery working parts—by 1.5 to 5 times. Various methods exist for restoring and hardening working parts, which increase their wear resistance and durability.

During the work on the dissertation, comprehensive research was conducted to improve the wear resistance of the coulter of a wide-row seeder and its components, specifically the coulter anchor, resulting in the following findings:

1. The design parameters of the coulter anchor were substantiated, and a hardening technology was developed (anchor length a, 76 mm; width b, 30 mm; height h, 42 mm; angle of inclination α, 50°);

2. The use of the developed hardening technology increased the wear resistance of the coulter anchor by 2.5–3 times (344.2 HV for the base model and 792.51 HV for the hardened model);

3. As the working depth and speed increase, the traction resistance of the coulter anchor of a wide-swath seeder increases, leading to an increase in the degree of abrasive wear (the resistance of the foot coulter was 86% (195.2 N), the anchor’s was 10% (31.18 N), and the inclined plate’s was 4% (8.83 N));

4. The results of experimental studies showed that as the hardness of the coulter anchor’s working surface increases, its wear mass decreases (the wear mass

of the hardened anchor was approximately 2.5 times lower than that of the base model);

5. A mathematical model of anchor wear was constructed in STATISTICA 10 using the “Design of Experiments” software package; As a result, it was established that increasing the hardness of the anchor’s working surface to 820 HV significantly reduces its wear rate, and the optimal anchor angle should be between 48 and 52 degrees;

6. The total economic benefit from using a hardened coulter anchor in a wide-swath seeder amounted to 16,243.57 tenge/ha, which amounts to 12,475,061.76 tenge for an annual actual cultivated area of 768 ha.

Research Objective: To develop a coulter anchor design with enhanced wear resistance for a wide-row seeder, thereby extending its service life.

Research Objectives:

- to analyze research studies on coulter designs for wide-row seeders, identify the causes of wear, and select the optimal hardening method;
- conducting theoretical research to justify the design parameters of the coulter anchor and the hardening of the working surface, based on computer modeling that allows for the determination of abrasive wear on working surfaces;
- developing a methodology for research and laboratory and experimental testing of the coulter anchor;
- conducting laboratory and experimental tests and processing the obtained data;
- assessing the technical and economic efficiency of using a hardened coulter anchor on a wide-swath seeder for applying seeds and mineral fertilizers.