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## TENDENCIES OF PARK OF GRAIN HARVESTING COMBINERS

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Harvesting is the most responsible stage of agricultural work [1]. High organization of harvesting, sufficient provision of technical means, timely and correct regulation of working bodies allows harvesting grown bread in agrotechnical terms and with acceptable losses [2]. In Ukraine, more than 98% of the areas under grain, cereal, leguminous crops and rice are harvested with grain harvesters [3].

Without exaggeration, the combine harvester today is a technically perfect object, extremely intellectualized, highly productive, energetically powerful [4]. Naturally, under such conditions, the total number of harvesters is gradually decreasing: in the period from 1990 to 2020, their number in agricultural enterprises of our country decreased by almost 72% and reached its critical level of 26,500 units. Under such conditions, the seasonal load on one combine harvester only for the harvesting of early grains in Ukraine increased to 240 hectares, while in the EU countries it is 80 hectares [5]. The number of grain harvesters in Ukraine per 1,000 hectares of arable land is 1.4 units, which is an order of magnitude less than in the leading countries of the world (Fig. 1).



Fig. 1. The number of grain harvesters per 1000 hectares.

Not simple economic conditions today force agricultural producers to optimize production processes, to look for ways to reduce costs. These issues are also relevant for the domestic agricultural industry. The decision regarding options for updating the fleet of equipment for the majority of domestic agricultural enterprises in today's difficult conditions should be reasonable, economically and technologically feasible.

Under such conditions, an important task is to find ways to increase the efficiency of the use of grain harvesters.

Analysis of the development of designs of grain harvesters indicates a significant increase in the efficiency of machines, which is associated with an increase in their productivity, high quality of work, operational reliability, equipment of combines with electronic control systems for work and technological processes.

In the development of grain harvesters over the last decade, the following main trends are noted:

- increase in throughput and productivity in the most powerful combines with a rotary separation system (up to 25 kg/s);
- increasing the power of the power unit;
- to increase productivity with the compact dimensions of the harvester, the area of the threshing device is intensively increased with practically unchanged other parameters, which is achieved thanks to the rotary or multi-drum threshing system;
- universalization of combine harvesters for harvesting various agricultural crops (corn, sunflower, etc.), improvement of working conditions for mechanized operators;
- increasing use of on-board information and control systems.

In addition, combine harvesters embody advanced achievements in ensuring environmental indicators and meeting safety requirements, in accordance with global standards and achievements: pressure on the soil up to 80-120 kPa, reduction of the content of harmful impurities in exhaust gases, reduction of dust generation, etc.

In the designs of modern grain harvesters, on-board information and control systems are widely used, based on the use of sensors and executive mechanisms of the mechatronic system of the combine.

In addition to sensors for monitoring the frequency of rotation of working bodies and sensors for controlling the level of losses by separating devices, sensors for course movement, recording of the harvested crop, humidity and clogging of bunker grain are becoming widely used. The use of global positioning systems allows you to build yield maps of harvested fields. The use of material flow sensors and electric servo-regulators of the transmission drive in the inclined chamber allows you to automatically change the speed of the harvester in the field. The use of electromechanical regulation of the modes of working bodies (sieve, fan, drum, deck, etc.) allows you to change the corresponding modes without stopping the threshing process.

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## **GRAIN LOSSES AT THRESHER AND GRAIN PURITY IN BUNKER OF GRAIN HARVESTER**

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The main indicators of the quality of work of grain harvesters are the total loss of grain after the thresher and the cleanliness of the grain in the hopper (Fig. 1). Losses of grain during threshing and separation are divided into direct, or irreversible, and indirect [1]. The first includes grain lost in one way or another that cannot be collected, the second includes grain that has lost its sowing, productive or bread-making qualities [2]. During harvesting and postharvest processing, the grain is subjected to mechanical action, as a result of which it is injured. Mechanical damage (macro- and micro-damage) negatively affects both seed and food grains [3].

Macro damage includes crushed, flattened and crushed grains [4]. Microdamages include grains with damaged germ, shell, and endosperm, as well as hidden internal defects such as dents, clogged areas, and cracks [5].

Grains with macro damage are usually few. The number of grains with microdamages sometimes reaches 50–80% or more, which sharply reduces the quality of seed, marketable, baking, and other grains. 0.5 tons of rye, 0.3 tons of spring barley, 0.2 tons of spring wheat, 0.6 tons of oats, and 0.8 tons of corn are not