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Trends in the process technology of grain crop harvesting

More threshing capacity - more control technology

Below, important trends in threshing technology are presented, which are going to characterize the Agritechnica 2005. This preview only provides pre-information and cannot replace a trade fair visit. Completeness is not aimed for.

The combine market is still characterized by globalization and concentration on a few manufacturers and locations of production. Apart from the lower and medium power classes, where conventional combines are still predominant, the uppermost power classes are showing a growing trend towards rotor combines, which are increasingly being equipped with control systems for the automation of steering and driving speed control.

Rotor combines ñ wider product range and optimized rotors

Due to the demands of the market, the manufacturers extended their range of rotor combines to ten different types from three different manufacturers. An end of this trend is not in sight because AGCO has also set itself the goal to develop a rotor combine which is suitable for the European market and is intended to belong to the upper capacity segment. The latest axial treshing- and axial separating rotors are more pointed in the gathering area, which improves crop gathering and the redirection of the crop flow while reducing the power requirements.

In the currently offered types, John Deere uses tangential rotor- (CTS) and axial threshing technology (STS) in two systems. In the 2005 season, the 9880i STS was equipped with the so-called High Performance Rotor. In the gathering- and threshing area, the tube of this rotor has a smaller diameter and a conical shape up to the threshing area. This design provides more space for the crops between the tools and thus improves the axial redirection of the crop flow, which is critical and requires a lot of power for system-related reasons. Especially in long, wet, and tough straw, this has a positive effect on threshing performance.

Case New Holland exclusively offers axial combines (AF, AFX, CR). Case markets the two known axial-flow combines 2366 and 2388, whose rotor tools, feed augers, as well as threshing- and rubbing segments have been improved. The rotor of the 2388 is also the core component of the AFX 8010. Many components, such as the header, the grain tank, the preparation pan with the cleaning system, and the chassis of the AFX are identical with those of the New Holland CR 980. The New Holland CR (960 and 980) is the only axial combine with two-rotor technology.

In the coming season, Claas is going to market the new Lexion 600 in addition to the known types Lexion 570 and 580. The Lexion 580, whose threshing unit is 1.7 m wide, is the basis of the Lexion 600. With regard to threshing and cutting, many details were improved, which results in optimal utilization of the threshing- and separating surfaces and, hence, technical threshing performance. One of the modifications was the upgrading of the feeding areas of the separating rotors equipped with tines in order to improve the crop flow and to reduce the power demand. The Lexion 600 is driven by a V8 Daimler-Chrysler engine, which has a maximum power of up to 430 kW according to EEC 80. Thus, it is the most powerful combine available. Its grain tank volume has a volume of 12 m^3. In a working position, the characteristic feature of the Lexion 600 is the funnel-shaped grain tank extension, which can be folded in contrast to the known funnels from the USA in order not to exceed permissible width and height. The Lexion 600 is the first combine with rear-wheel steering which is approved for a driving speed of 30 km/h. The engine speed is controlled depending on the driving speed.

Wider headers for flexible use

Growing threshing performance is going to lead to increasing working widths in order to keep the driving speed of the combines of the uppermost power classes within tolerable limits for the driver and a proper work process. Therefore, the current maximum header widths of 9.15 m are going to be exceeded in the foreseeable future. One indication of this development is the extremely long, folding loading auger of the John Deere 9880i STS, which allows for problem-free parallel driving during loading even at cutting widths of up to 10.7 m. For transport and manoeuvring and while the combine is parked in the machine hall, the auger is folded electrically behind the combine.

For the optimization of the crop flow, John Deere presents the new Premium-Flow header of the supplier Zürn. In principle, this is an upgrade of the Power-Flow header from MF. However, it is characterized by numerous patented detail improvements. The band segments, for example, can easily be folded up individually. This not only facilitates maintenance, but also cleaning for batch change during seed growing. In addition, the rape-separating knives which are always on board and driven mechanically by the main knife drive can be coupled easily.

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Keywords

Trends of development, threshing technology, increasing capacity, logistics

Fig. 1: With the Lexion 600, Claas currently offers the strongest combine (company photo)

In addition to the above-mentioned active crop-flow headers, the so-called Vario headers, which have a variable cutting table length, are offered by more and more manufacturers: Not only Claas, Geringhoff, and Schrattenecker, but also New Holland now manufacture Vario headers. This trend towards active crop flow and variable table length proves that the optimization of the crop flow in the header is a key to high threshing performance.

BISO Schrattenecker, the Austrian specialist for harvesting headers and choppers is not only focusing on crop flow optimization in the header, but also on loss minimization. Its new sunflower harvester is equipped with a covering cap vibrator for loss reduction. A header with a flexible cutter bar, which is equally suitable for the harvest of grain, rape, peas, and soya beans and thus saves investments for different headers in complex crop sequences, is also new. Automatic locking of the header on the transport wagon is intended to provide shorter ways for the driver and thus to reduce transfer times.

Straw choppers ñ new avenues

Since headers are becoming wider and wider and the agricultural and agronomical demands on chopping quality and straw distribution are growing, chopping technology in the combine is reaching its technical-physical limits. The shorter straw is chopped, the larger its surface becomes, which consequently leads to faster rotting and a higher conversion rate. However, the shorter the straw is, the more difficult it becomes to blow-spread the fine particles over the entire working width. High susceptibility to sidewinds and large engine power demands are additional disadvantages. The power consumption of a modern chopper can easily reach 100 kW. As compared with swath deposition, this corresponds to an approximate additional 25 l/h of diesel consumed by the combine. Therefore, chopper manufacturers and suppliers, such as the blade manufacturer Raspe, are improving cutting and spreading technology.

For its 9880i STS combine, John Deere offers the premium chopper with chaff management developed by the Swedish manufacturer Rekord, which features two spreading fans behind the sieve shoe. If the straw is deposited in swaths, the spreading fans discharge the chaff on both sides, and the straw remains chaffless. When the chopper runs, the direction of rotation of the spreading fans is changed. Then, the chaff is blown to the rear to the outer baffle plates under the spreading cap. The chaff and the air volume flow carry along the chopped straw behind the rotor, which is strongly accelerated and blow-spread far to the side over the working width of 9 m.

Claas equips the two combines Lexion 570 and 600 with two spreading rotors instead of the spreading fan with swinging nozzles known from the Lexion 480/580. The rotors pick the chopped straw up tangentially from the cutting rotor and spread it on both sides. Spreading range and direction are altered by changing the wrap angles and -times of the fan casing around the rotors.

Control technology guarantees good performance

Automatic steering systems reduce the driver's workload and increase the campaign output by means of precise parallel tracking. The trend is favouring two fundamentally different systems:

Sensor-based automatic steering system: A laser scanner scans the crop edge. Since the distance between the scanner and the crops is shorter than the distance between the scanner and the stubble, the reflection times of the crops are shorter. Thus, the edge is localized, and the electro-hydraulic steering system is controlled such that the crop edge is always in the middle of the scanned area. The most well-known system of this kind is the Claas Laser Pilot, which is marketed since 1999. Since the 2005 season, New Holland offers its SmartSteer system, which is also based on laser technology. The sensor is installed on the cab roof of the combine.

GPS-based automatic steering system: With the aid of satellite navigation, the combine is localized with a maximum accuracy of ± 2 to 3 cm. An accuracy of approximately ± 10 cm is generally sufficient for a combine. Depending on the programmed working width, the machine is guided along an initial guideline and steered over the field parallel to this guideline at a distance of one or several working widths. This is the working principle of the systems AutoTrac from John Deere, Claas-Agrocom (GPS-Pilot, System Outback) or Case New Holland (Autopilot, System Trimble).

For the first time, John Deere equips the conventional combines of the WTS series with the optional throughput controller HarvestSmart. In 2001, this system was presented for the axial combine STS. It causes fewer problems to equip a rotor combine with a throughput controller than to install such a system on a conventional combine because the losses do not vary so much at changing driving speeds due to the flatter course of the throughput-loss curve. In conventional combines, however, losses grow discontinuously when a certain throughput is exceeded. In this case, the throughput controller must work sensitively after a short reaction time. HarvestSmart allows the driver to decide whether the combine works at maximum engine power or at maximum losses.

If the throughput controller and the automatic steering system are used at the same time, this is another step towards the automation of combining.

In the 2006 season, Claas is also going to offer a throughput controller in the Lexion 600. In addition to the utilization of engine capacity, crop layer thickness in the feeding channel is measured. In the channel, a sensing roller is installed whose deflection corresponds to current crop layer density. In combination with the utilization of engine capacity, the driving speed is controlled appropriately.

Since the setting of large-capacity combines is becoming more and more difficult, solutions based on wireless communication offer themselves. Set values are transmitted to the control centre so that the person in charge can provide help if required. It is also possible to request settings from an expert system on the internet, which the driver uses under changed harvesting conditions in order to optimize the machine setting. Or a combine automatically takes over the setting of another machine which works in the vicinity under comparable harvesting conditions and is operated by an experienced driver. These examples show that many more innovations are going to establish themselves in the grain crop harvest with the aid of upgraded information systems and thanks to the use of modern communication techniques.