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Trends in the Process Technology of Grain Crop Harvesting

More Threshing Output for Greater Campaign Capacity

In this contribution, important trends in threshing technology are presented which are going to characterize the Agritechnica 2003. This preview only provides pre-information and cannot replace a trade fair visit. Completeness is not aimed for.

Globalization and concentration on a few manufacturers remain characteristics of the combine market. Growing farm size leads to increasing threshing capacity requirements. Since large daily area capacities of 300 to 500 t of wheat can no longer be reached with conventional combines depending on the harvesting conditions, the manufacturers are offering more and more combines with rotary separating technology.

More Rotary Combines Available

The growing popularity of rotary combines must primarily be attributed to their throughput-loss characteristics. In contrast to conventional combines, the characteristic curve of rotary combines increases only slightly with growing throughputs of straw and chaff. As a consequence, a rotary combine of the highest capacity class can replace two conventional combines at an elevated loss level. The resulting reduction of combining costs by approximately € 3 to 5 per tonne was realized by many farms in the past years.

Combines of this highest capacity class are marketed by Claas, John Deere (for two years), and New Holland (as of the past season). In contrast to the tangential thresher with axial rotors for the separation of non-separated grain in Claas combines (Lexion 470 and 480), these are axial combines with one (John Deere 9880 STS) or two rotors in machines from New Holland (CR 960 and 980). In comparison with tangential technology, axial threshing is characterized by rubbing rather than beating threshing, which results in less damage to the grain.

In axial rotors, however, straw is ground to a large extent. As a result, brittle straw in particular is less or not at all suitable for the harvest. Therefore, the future marketing success of axial combines will certainly also be dependent on the value of the straw in the different farm types and regions.

Tangential rotary combines are offered by Claas and John Deere. The strengths of these machines primarily reside in their great ability to adapt to different harvesting conditions because they allow the rotational speed of the rotor to be altered in addition to the usual thresher settings. On the one hand, this provides high threshing capacities. On the other hand, low rotational speeds of the rotors enable the straw to be treated relatively gently. Tangential rotary combines feature a more sophisticated design than axial combines. Consequently, their production is more expensive, which exerts an effect on the purchase price. Their versatile use, however, speaks in favour of this system. The number of units sold in Germany confirms this: the Lexion 480 from Claas is the most frequently sold combine.

At the Agritechnica, Case is going to present the new axial combine AFX with one rotor. For the first time, the rotor is driven by a powersplit transmission. Especially in the chassis area, many components of this combine are identical with those of the rotary combine New Holland CR. This new machine adds a top model to the old AF series. Case remains true to the „one-rotor combine“ principle by offering a simply designed combine which features only a few structural components.

Foto Case IH

Fig.1: Case presents the new axial flow combine 8010 AFX at the Agritechnica

Claas redesigned the Lexion series. The combines, now termed 500, are better equipped with greater engine power and altered technical details. The Lexion 580 is driven by a V8 Daimler-Chrysler engine with a maximum power of up to 377 kW. The engine power of the Lexion 570 (Caterpillar engine) was raised to 320 kW in order to provide sufficient power reserves under difficult harvesting conditions.

Since the harvest of crops with brittle straw can lead to sieve pan overload in rotary combines, the Lexion 570 features a new concave sealing technology. From the driver's seat, some of the separating concaves underneath the rotors can be covered with metal sheets (similar to the de-awning sheets in the threshing and pre-concave) so that less straw damage enables total combine capacity to be kept high.

John Deere is the only manufacturer who offers two different threshing and separating systems: the tangential combine 9580 CTS with an engine power of 264 kW has remained unchanged since the last Agritechnica. This also applies to the axial combine 9880 STS with an engine power of 353 kW. This most powerful John Deere combine is primarily bought by large farms which harvest little straw and intend to replace two conventional combines with a rotary machine.

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Keywords

Trends of development, threshing technology, increasing capacity, logistics

The new axial combines of the CR series from New Holland are an upgrade of the TR (twin rotor) technology from the 70s. However, the CR combines were redesigned in many details and will be presented to a large public in Germany for the first time at the Agritechnica 2003. Many components of the CR 980 model are identical with those of the CX combines with six walkers. At an engine power of 315 kW, it is the most powerful machine. The CR 960, which has an engine power of 245 kW, is based on the 5-walker combines. The core components of the CR combines are the two axial rotors with diameters of 43 (CR 960) and 56 cm (CR 980). The feed augers gather the harvested crops directly from the elevator and divide the crop flow to feed it into the two counterrotating rotors. Behind the rotors, a separator drum throws the straw into the chopper.

A special characteristic is the stone protection trap in the feed canal, which has won several awards. Knock sensors detect the rumbling sounds of stones and unlock the elevator floor. At the same time, the thresher is shut down, and the forward drive is stopped. After the driver has lifted the feed canal and relocked the trap, the ride can continue. This allows expensive damage to be avoided.

Conventional Combines in Different Colours

It has become virtually impossible to increase the threshing capacity of conventional combines because the sophisticated walkers extend the design volume to its permissible limits, which may not be exceeded primarily due to transport width limitations. Therefore, no novelties with regard to the dimensioning of the threshing- and separating units of conventional combines can be expected.

Within the CNH group, Case markets the TX combines from New Holland as CT combines. Under the well-known brand name Laverda, combines with swivellable separating concaves are marketed by the Landini group. In order to improve the separation of non-separated grain, the combines from Fendt and Massey Ferguson, which feature a threshing canal width of 1.68 m, are only sold with eight walkers.

In order to fulfill smaller investment wishes, Claas with its Mega machines (350 and 360) and New Holland with its CS machines (520, 540, 640, and 660) now follow the model of John Deere¥s combines from its Brazilian factory (CWS 1450 and 1550) and offer combines which feature proven threshing- and separating systems along with altered outward design and improved operating comfort. New Holland upgraded the thresher of the CS combine: for the first time, the wrap angle of the concave was able to be reduced from 121 to 85 degrees in order to reduce the straw load caused by the walkers and the sieve pan. The combines with the well-known threshing- and separating elements from Deutz-Fahr are now built in the Dronningborg factory in DK-Randers and marketed with different equipment characteristics and model designations of the manufacturers Deutz-Fahr, Fendt, and Massey-Ferguson.

Equipment and Accessories

Additional equipment, such as steering aids, also serve to increase campaign capacities. For the 2004 season, Claas is going to offer the Lexion combines with optional laser pilot sensors on both sides in order to facilitate back-and-forth harvesting. John Deere has the automatic steering system GreenStar Auto Trac for tractors and combines in its product range.

For the optimization of the crop flow in the combine, Claas is going to offer the Vario cutter, whose table length can be altered from the driver's seat, with a working width of 9 m as of the coming season. In addition to Claas and Schrattenecker, which use this technology, MF and Fendt equip their combines with the well-known Power-Flow cutter, which is part of series equipment in most cases. This cutter actively conveys the harvested crops to the feed auger with the aid of a conveyor belt. Geringhoff also offers a vario cutter with a belt- and chainless drive, while Schumacher equips combines with roller guidance for oscillating mowing knives. Especially cutter design reflects the harvesting conditions, which are very different worldwide: while in Western Europe cutters with long or variable tables featuring widths of up to 9.15 m are used, farmers and contractors overseas are increasingly employing draper cutters with conveyor belts.

Since despite structural change the cutter must often be mounted and demounted in small-structured areas, the combine manufacturers are trying to simplify this coupling process. As of the coming season, John Deere is going to offer an automatic locking system which mechanically locks or unlocks the cutter when the hydraulic and electric lines are coupled.

In order to reduce tank unloading frequency, the grain tank volumes of the combines are being increased. After the Lexion 480, Claas is going to market the rotary and conventional combines Lexion 570 and 560 with a grain tank volume of 10.5 m^3 as of the coming season. New Holland also indicates this volume for the large models of the CX and CR series. In the 9880 STS, John Deere offers a tank volume of 11 m^3. It is rather unlikely that the tank volumes are going to grow further because depending on the header the wheel loads of the front axle exceed 10 t when the tank is full.

The chopping and distribution of the straw remains a challenge for design engineers. The manufacturers build chopping rotors equipped with 4, 6, or even 8 knife rows. At the same rotational speed, this results in decreasing theoretical cutting lengths which, however, often cannot be durably realized in practical operation.

Since 1995, active distribution with the aid of throw blowers has been very successful in the Claas Lexion 480. As of the 2004 season, Claas is going to offer another active distribution system for the Lexion 570: two throwing rotors gather the chopped straw tangentially from the cutting rotor and distribute it on both sides. Throwing width is set using oscillating cover plates.

In order to increase operational reliability and process monitoring, the manufacturers of self-propelled machines are developing on-line control systems. These telemetric systems record the most important machine data, such as engine speed, driving speed, and throughput, as well as the error messages of the diagnostic system.

Fig. 2: Tele monitoring of the grain harvest is technically already realisable Photo Claas