EAR CORN DRYING & PROCESSING

TURNKEY
Handling, drying and processing of ear corn requires in-depth knowledge to avoid damage to the seeds and to preserve the germination ability.

Cimbria is one of the world’s leading manufacturers of equipment and plants for seed processing. Based on in-house technology and experience, we have the capability to carry out full design and supply of ear-corn projects on turn-key basis.

A firm project management control supports the assurance for the security and quality that lies in our products and project execution. From placement of the order to the guarantee expiration, the responsibility for your project lies in the hands of an experienced and dedicated senior project team.
The ear corn is received directly from the field and enters an area for sampling, testing and quality control.

Prior to entering the receiving area for unloading, the trucks pass a weigh bridge for control.

**RECEIVING AREA**
The ear corn is tipped directly into the intake pit. The intake pit is equipped with a walking floor for gentle and even transfer of the ear corn into the belt conveying system from where it is conveyed into the husking and sorting area.

**HUSKING & SORTING**
A distribution conveyor fills the pre cells above the huskers, from where the ear corn is conveyed to the husking process by means of a shaker feeder and a belt conveyor.

Side by side husking rolls removes husk and silk from the ear corn. The waste products are collected and conveyed to a dump area, alternatively for chopping.

Loose kernels can either be collected by a loose kernel belt conveyor and re-covered, or they can be discharged by the waste conveyor.

**HANDSORTING**
After the husking process, the husked ear corns are visually controlled and inspected at the sorting table. Un-husked ear corn is re-run for re-husking. Bad and low germination ear corn are removed and discharged into a waste belt conveyor.

**OPTICAL SORTING**
 Optionally an optical sorter can replace the main part of the manual inspection. This reduces the labour force by approx. 75%.
Drying of ear corn is a complex process, which in the past traditionally depended on operator experience. Given the high value of good quality seeds the process must be optimized in order to secure quality and minimize energy consumption while at the same time maximizing the plant capacity in a controlled manner using the latest automation systems to monitor, control and finally save all process data.

Seed corn is usually harvested as ear corn with a moisture content of 30% to 40% and it subsequently needs to be dried down to 12-13% for safe storage. With such huge moisture reduction, very gentle and accurate drying is crucial in order to avoid cracks in kernels, which will reduce the chance of germination rate. The optimal values of bed-depth, the up- and down air flows and temperatures are of great importance for the drying process.

The drying process is influenced by many parameters:

- Ambient temperature
- Relative humidity
- Air flow and Air distribution
- Seed variety / hybrid
- Bin depth
- Initial and final moisture requirement

To design and operate the dryer, it is important to understand and control the nature and characteristics of all these parameters.

The Cimbria dryers are built as a modular chamber system and can be designed as either single-pass dryers or double-pass dryers.

The dryer walls are made as trapez-shaped steel profile. The inclined bottom is made of perforated sheet steel which allows the drying air to pass through.

The dryers are supplied with filling doors, entrance doors to air channels, air dampers, shell out doors and staircases and catwalks. Filling doors, air dampers and shell out doors can be supplied pneumatically or actuator controlled.

Design and supply of steel construction, roof construction, access etc. is tailor made so each dryer is designed according to the individual demands and requirements of the client.
The single pass reversing dryer is constructed with two rows of drying bins arranged opposite each other. The area between the bins is used for transport of ear corn out of the dryer.

Each bin has its own independent heating source and drying ventilator which are installed at the air plenum on the outside of the drying bin.

The ventilators blow hot air into the plenum. First upwards through the drying bin and out to atmosphere, later down through the drying bin and out into the atmosphere.

Advantages of Single Pass Dryers

- Very flexible as each bin has its own ventilator and temperature control and can be individually controlled
- Useful for different hybrids with different drying temperatures
DOUBLE PASS DRYING

The double pass dryer is constructed with two rows of drying bins arranged opposite each other. Ear corn is transported from the dryer from shell out doors on the external bin walls of the dryer.

The drying bins have a common heating source and drying ventilators which are installed at both ends of the dryer. Depending on the dryer size the double pass dryer is supplied with two or four ventilators and heating sources.

The ventilators blow hot air through the bins containing the driest ear corn and into the lower plenums and then upwards through the high moisture bins and out into the atmosphere.

Advantage of double pass dryer:
- Low power consumption
- Lower capital cost

AIR CHANNELS
Remotely controlled air louvers for:
- guiding hot air bottom and up
- guiding hot air top down and to air plenum to bottom up to atmosphere
- equalizing air pressure between upper and lower air plenum
Under the bins access doors for cleaning and inspection are located.
BOX DRYING AND HEATING SOURCES

BOX DRYING
Box dryers are mainly used for small batches and loose kernels recovery. The boxes are loaded into the dryer in the front end by a forklift. The box dryers are either for one or two rows of boxes. At the rear end, the heating and fan systems are placed. The distribution takes place via the common air channel in the dryer.

HEATING SOURCE
For the drying process, we provide heating systems for heating by liquid or natural gas, oil, steam and hot water.

HEATING WITH GAS
The most common used heating source is the gas burner system. It is supplied as a package which includes a pre-assembled module, temperature sensors and PLC Control Panel with VLT controlled motor for the ventilators.

HEATING WITH OIL
The oil burner package includes an oil burner module, temperature sensors and PLC Control Panel with VLT controlled motor for the ventilators.

HEATING WITH BIOFUEL
This heating system offers an opportunity to use waste products from the husking and sorting process and cobs from the shelling process as fuel to deliver hot water or steam to heat exchangers on single and double pass dryers.
SHELLING AND PRECLEANING

Shelling is a mechanical process where the corn kernels are separated from the cob. The shelling process must be done as gently as possible to reduce kernel damage to a minimum.

SHELLING
The Cimbria sheller operates with a corn on corn shelling action and is equipped with a sturdy steel housing with a forged rotor.

The shelled cobs are conveyed to a cob bin for truck load out or to a dump area.

PRE-CLEANER
A Delta pre-cleaner is used for scalping of corn cobs and other large impurities in the upper screen layer. The lower screen layer is used for sifting smaller particles, soil and broken kernels etc. The pre-cleaner can be supplied with an aspiration system for removal of light impurities.

OPTIONS
BULK SCALE
A bulk scale can be incorporated for recording the amount of pre-cleaned shelled corn being transferred to bulk silos.

BIG BAG WEIGHING UNIT
A big bag weighing unit can be incorporated for big bagging of the pre-cleaned corn being transferred to warehouse for intermediate storage prior to conditioning.

AUTO SAMPLER
An auto sampler can be incorporated for taking seed samples of pre-cleaned corn for transfer to a laboratory for quality control.

ASPIRATOR
If the pre-cleaner for scalping is operated without aspiration, a separate aspirator must be installed to remove lighter particles such as bee wings and other light impurities prior to big bagging / bulk storage.
During the process the corn must be stored for temporary storage and dosing.

The silos are integrated into the plant flow for storing of
- Shelled corn
- Per-cleaned corn
- Treated corn
- Cob waste

For the storage, Cimbria offers a wide range of silos tailor made according to the actual request in the single projects.

The silos are delivered with statically documentation for the calculations and manufacturing according to the local building regulations (i.e. EN1090 within the European Union)

The design of the Cimbria silos is optimized for corn and other types of seed, which must be handled very gently to preserve the germination ability.

When filling the cells, the corn is cascaded at reduced speed in order to prevent damage because of high velocity. The product temperature in the single cells can be monitored continuously and the measurements are logged in the SCADA system. The cells are designed with aeration which facilitates the possibility of ventilation of the single cells.
CLEANING

In the fine cleaning process, under size as well as over size corn kernels which are not suitable for seed are separated from good corn kernels. Again the corn is aspirated for removal of light particles.

FINE CLEANING
It is of outmost importance that the corn seed is well cleaned. The Cimbria range of Delta cleaners are able to perform the best cleaning due to vibrator feeder securing an absolute even feeding and distribution on the screens. Moreover the highest % apertures on the market ensure maximum utilization of each square meter of screen. Finally a very efficient airlifting system will remove all light material.

FLAT SCREEN GRADING
When using a Cimbria Delta flat screen cleaner, width, length and thickness grading will be carried out by combining the optimal screen aperture and screen slope with the length and frequency stroke as well as very efficient air lifting system. The corn will be separated into the fractions required.

CYLINDRICAL GRADING
When using a Cimbria Cylindrical screening machine for grading the product is sorted according to its width or thickness. Each single cylinder is built as a self-supporting steel construction and can be combined in various configurations by means of the simple modular system. This offers a huge spectrum of sorting options possible. By combining a number of cylindrical machines, calibrations can be made into as many fractions as required.
In the process of grading by size, seeds can be separated according to the criteria of width and thickness on one hand, and length and particle shape on the other hand.

Calibration into different fractions can be made by the use of flat or round screens.

**WEIGHT SEPARATION**

The separation by weight is performed on a Cimbria Gravity table which efficiently will remove any stones or foreign seeds having the same length and width as the good product but a different weight. The gravity table uses a fluid bed principle combined with a combination of adjustable inclined motions.

**OPTICAL SORTING**

By the use of the very latest technology the Cimbria SEA optical sorter will finally remove maize kernels having a different color or visual damages. In the optical sorter, the feeding system carries corn through oblique chutes where it is further separated.

The product then falls through an analysis section where each particle is checked by a number of optical devices facing each other. Any color characteristic electrical signal is taken to a control unit which converts it. Should non-designated particles be present, these are shunted off to the discard bin by means of an air blast fired by ejectors.

The sorters are controlled by microprocessors and their sophisticated software allows the use of up to 600 different sorting programs storable on board. Thanks to this they apply to manifold production needs, since the same machine is able to carry out different sorting process of the same product or of different products, in a matter of a few minutes.
CHEMICAL TREATMENT

Seed Treatments is a chemical or biological substances or physical processes applied to seeds or seedlings. They help to protect the seeds and assure optimum emergence of the crop.

Application of a chemical to seeds is a very well-targeted method of reducing attacks on the growing plant by insects and diseases. Fungicide treatment to control seed and soil borne diseases. Insecticide based treatment for season pests in a broad range of crops.

The Cimbria centricoater is designed for the most precise and uniform application of costly seed treating materials. The system is a continuous batch operation utilising a highly accurate electronic scale together with an equal accurate chemical dosing system all controlled by a PLC. The system provides a uniform distribution of the treatment materials on the seed.

POWDER FEEDER
Integrated powder feeder for injection of powder materials, talcum or other substance for weight gaining.

LIQUID DOSING SYSTEM
Glass cylinder for direct dosing, simple manuel directly Flow Meters or Mass Flow Meters for volumetric or gravimetric dosing, amount programmed by recipe.

FORMULATION SYSTEM
Fully automatic mixing and formulation systems are tailor made according to your requirements. The system typically consists of:

- A rack system containing a number of IBC chemical containers, including spill try and pumping arrangement (Cruiser, Poncho, Insecticide, fungicides etc.)
- Mixing Tanks (MT) 1,2,3 etc. on load cells for mixing formulation from IBC tanks, and pumping system to deliver recipe to work tanks at centricoater
- Rinse water tank for clean out piping system and avoid cross contamination of chemicals
- Wash water tank for holding rinse water and add to waste water to mixing tank for those chemicals that can be allowed
- Waste water IBS tank for disposal of waste water which cannot be re-used

JOG CONVEYOR DRYER
If the treatment process applies large amount of liquids and powers, the seed needs to be dried before it is further handled.

The jog conveyor dryer operates with a gentle jog motion and can be heated by gas, oil, or electricity. As an option the dryer can be equipped with a sifting section for separating any loses powder and light material. The jog conveyor aspiration system must be connected to red dust filter.
PACKAGING SYSTEM

The treated seed corn is packed in a number of different bags depending on region, tradition, bag size, bag type etc.

The packaging systems are very individual in their lay out ranging.

From a simple netto bag weigher with open mouth bag, manual sewing and stacking of bags on pallets to the more advanced systems including automatic bag placement and flattening, automatic sewing and robot palletizing and wrapping systems.

DUST FILTER SYSTEM

Dust appears in all seed plants especially at the transfer points where the seeds are conveyed from one machine to another. Dust and bee wings are separated from the seed and create an unpleasant and dangerous environment for the workers, including the risk of a dust explosion. Therefore a correctly dimensioned and integrated aspiration system is an absolute must in any modern seed plant.

The dust filters are equipped with filter bags which separate the air before discharge to the atmosphere.

Dust aspiration piping must be properly designed according to air quantity, air velocity and pressure. The ventilators create the under-pressure that extracts the air from all extraction points. The air-locks discharge the dust to either bag or to a conveying system to a dust bin. The red dust from the treatment process requires separate dust filters. These filters are equipped with collection baskets as the toxic waste must be disposed of in a safe manner.
AUTOMATION

A modern facility is not utilized optimally without an effective and reliable control system. A Cimbria control system combines our many years of process experience with the latest technology. This is your guarantee that all installed machines operate at their optimal performance thereby ensuring the best economy of the entire system throughout the life time of the plant.

SCADA SYSTEM

The Scada system is tailor-made for operation, monitoring and alerting and it can be controlled by the operator from one or several locations. To secure the daily operation, all routes are saved and stored and can be easily accessed.

Our preferred system is WinCC from Siemens. A powerful, user friendly, high performance PC based Human-Machine Interface (HMI) together with Microsoft Windows.

TRACEABILITY

Seed represents a great value, therefore traceability is extremely important. A very well-tested and stable database system is normally built in Microsoft SQL. The logging is typically done using a barcode system, but other systems such as RFID systems are also available.

SERVICE PROGRAM

To minimize the risk of breakdowns and plant downtime, operating statistics on each machine can be set and monitored enabling scheduled service and preventive maintenance to be done on time.
The Cimbria Unitest system is an important tool to ensure the products during storage in silos. Based on experiences from thousands of installations all over the world, the system monitor the storage conditions.

The Unitest is available in various applications:

**SINGLE HOST:**
A complete functional UNITEST 5G to run on a single PC without connection to a LAN and the Internet.

**SEVERAL HOSTS:**
Collection, storage and presentation can be distributed on several PC hardware connected by LAN.

**MULTIPLE SITES**
In this topology several sites are connected to a central "Super Site"