

## **CEREAL REFRIGERATION**

During the storage period, cereal can undergo transformation processes mainly triggered by the variation in external air HUMIDITY and TEMPERATURE values

The variation of such parameters affects both caryopsis metabolism and pest proliferation/activity.

Unfavourable values can lead to quality degradation and decrease in stored grain weight

Metabolic and pest activities can manifest themselves in the form of:

- caryopsis structure alteration;
- protein denaturation;
- starch destruction;
- water vapour formation;
- product contamination and pollution (germination processes)

The only true solution to this problem is subjecting the product to an accurate controlled

## **REFRIGERATION**

process, which is the *safest, healthiest, most effective and cost-effective* grain conservation method.

Cereal coolers operate, adapt and manage the conservation process regardless of the external climate conditions

## GRAIN FEATURES

### *Poor heat conductors*

Grains are poor heat conductors (thermal insulating properties); they do not allow heat exchange with the outside (heat transfer).

Contrary to popular belief, even in the event of steel silos, heat does not enter, despite steel being a good conductor, because the mass does not transfer or exchange heat with the outside.

The hot flow moves from the sunny side to the shady side where it is dissipated. No insulation required

### *Grain breathing*

Even after threshing, grains continue to breath, absorbing O<sub>2</sub> from the surrounding air and expelling CO<sub>2</sub>, water, and heat.

The grain breathing process increases with the increase in Moisture and Temperature.

Weight loss due to evaporation and the development of heat are enhanced when the grains are not stored at an optimal temperature

### *Hygroscopic properties.*

Whatever the conditions, grains tend to reach a balance between water content and outside air relative humidity (expressed by ADSORPTION ISOTHERMS).

This balance depends on temperature and on the intrinsic features of the cereal.

A dried wheat grain becomes more moist and starts to deteriorate when exposed to humid air.

## QUALITY AND SAFETY

An appropriate and dedicated refrigeration process allows the grain to acquire added value in the form of higher quality and food safety.

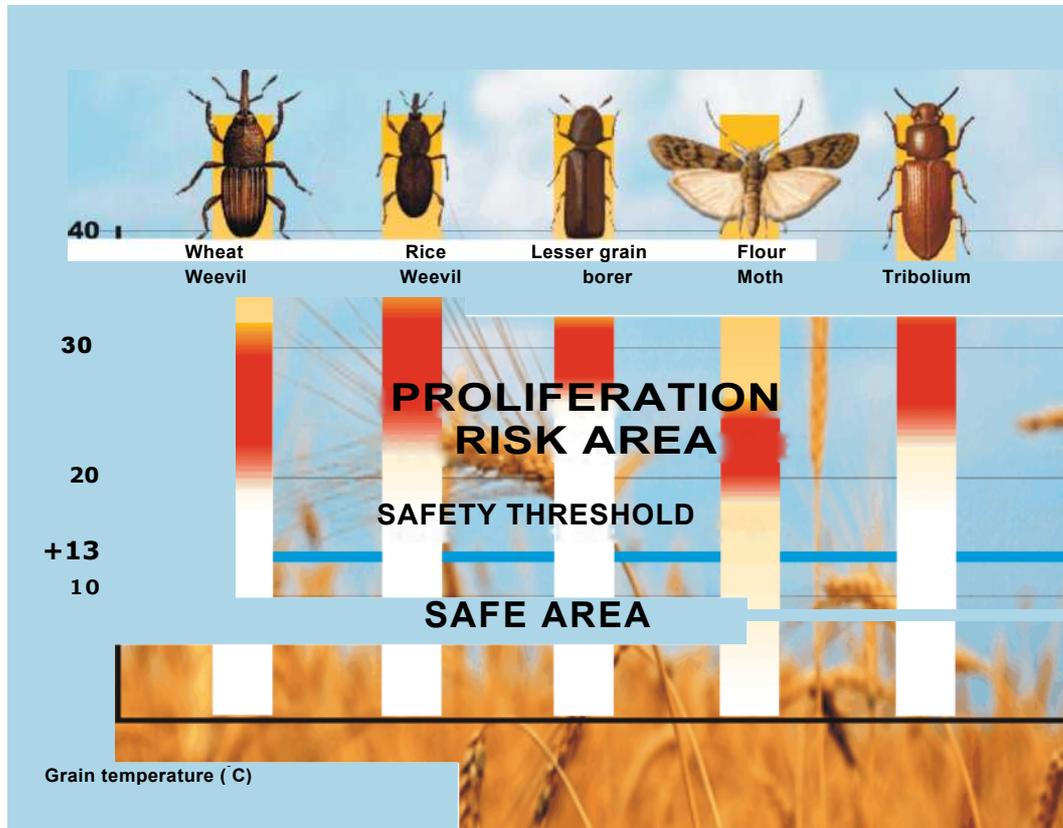
## WEIGHT LOSS

It is estimated that, in one month, grains stored at + 30 °C with 15% moisture undergo a 0.30% weight loss, whereas at + 10 °C, this weight loss drops down to 0.02%. Moreover, a broken and/or cracked grain breathes 7 times more than a whole, intact one. It is advisable to eliminate these broken parts (cleaners) to ensure optimal conservation.

In general, cereals have a typical microflora that remains inactive under optimal conservation conditions.

**BLOCKED MICROORGANISM ACTIVITY**

Development/proliferation of the main species of insects according to temperature



Cereal is alive and breathes even after harvest.

The breathing process expels CO<sub>2</sub>, water, and heat

The development of microorganisms is accelerated as the temperature increases.

Reducing grain temperature below +13 °C (safety threshold value) through refrigeration blocks insect metabolism and reproduction, keeping the grains under safety conditions. Refrigeration hibernates insects, which stop feeding and reproducing themselves and the eggs cannot hatch.

It is estimated that a temperature increase with 10 °C below the +13 °C isotherm leads to an increase between two and five times the number of microorganisms

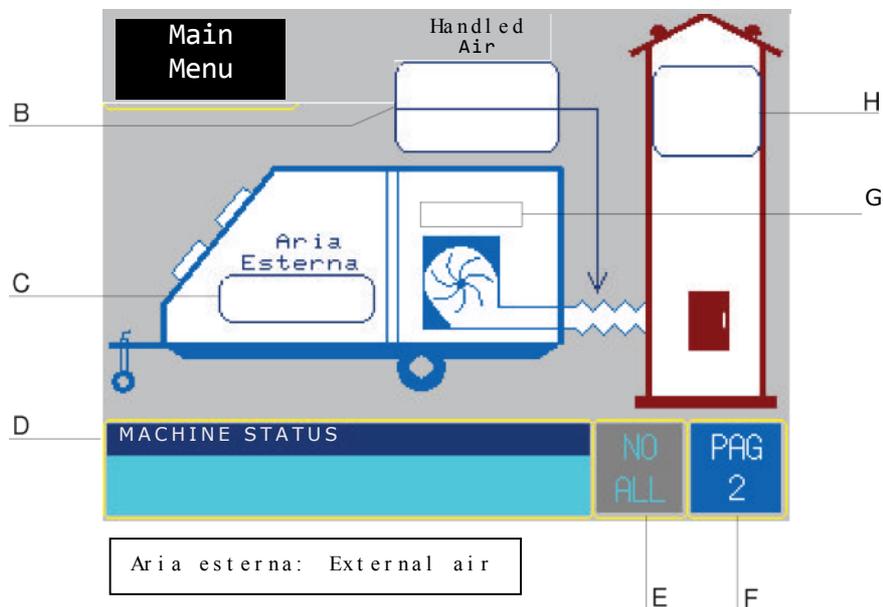
## SOFTWARE AND DISPLAY

Every unit is equipped with software and refrigeration system (which has been optimised over the years), ensuring:

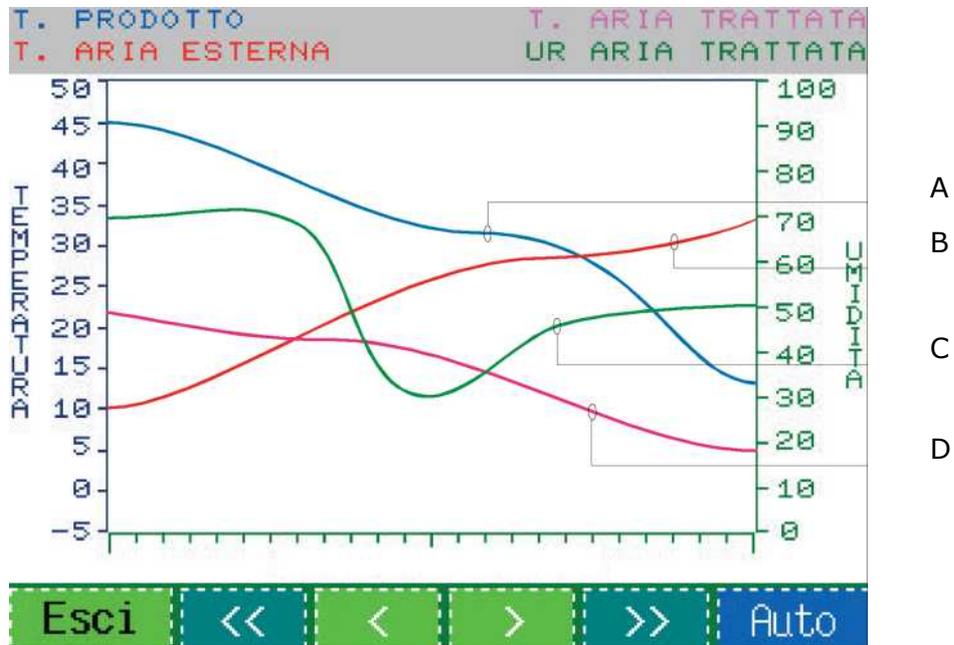
- higher cooling capacity;
- considerable consumption reduction.

Every model has a Touch Panel, whose setting allows you to view, record, and monitor parameters *in real time*. Parameters include:

- product temperature;
- air handling temperature;
- air handling relative humidity;
- Hot-gas post-heating heat pump;
- Flow rate damper servomotor;
- Handled air temperature and humidity;
- Condenser fan rotation speed;



Screen example



**Screen example**

## REFRIGERATION ADVANTAGES

- 1) Replaces chemical treatments (harmful and very expensive). Avoids the use of pesticides;  
The use of **chemical treatments** is expensive and complicated.  
They eliminate adult insects, but not the eggs. This is why treatments need to be repeated several times.  
Moreover, these treatments are subjected to ever increasing restrictions

- 2) Reduced conservation limitations and costs of alternative treatments;

*Alternative treatments:*

**Ventilation** alone encounters many limitations in the event of fog or rain.  
It leads to high consumption rates and poor results

Cereal **handling** alone can lead to broken or cracked grains, thereby promoting pest infestation or phenomena, such as fermentation and mould.  
Therefore, it is highly recommended to prevent grain breaking and cracking, which mainly occurs during threshing, handling with shovels or other machinery. Thin cracks are even more prone to infestation and aggression by insects and mould.  
Cracks and infestations are the optimal conditions for quick deterioration

- 3) A sudden grain temperature drop stops any pest activity;
- 4) Pile self-heating phenomena no longer occur  
because the temperature is maintained at optimal levels and the grain breathing process is reduced to minimum values;  
Loss is reduced by 10-15% in one season;
- 5) (in the event of corn) it generates a zero-cost partial drying effect, thereby reducing dryer power consumption;  
Boosts the drying system and reduces drying costs;

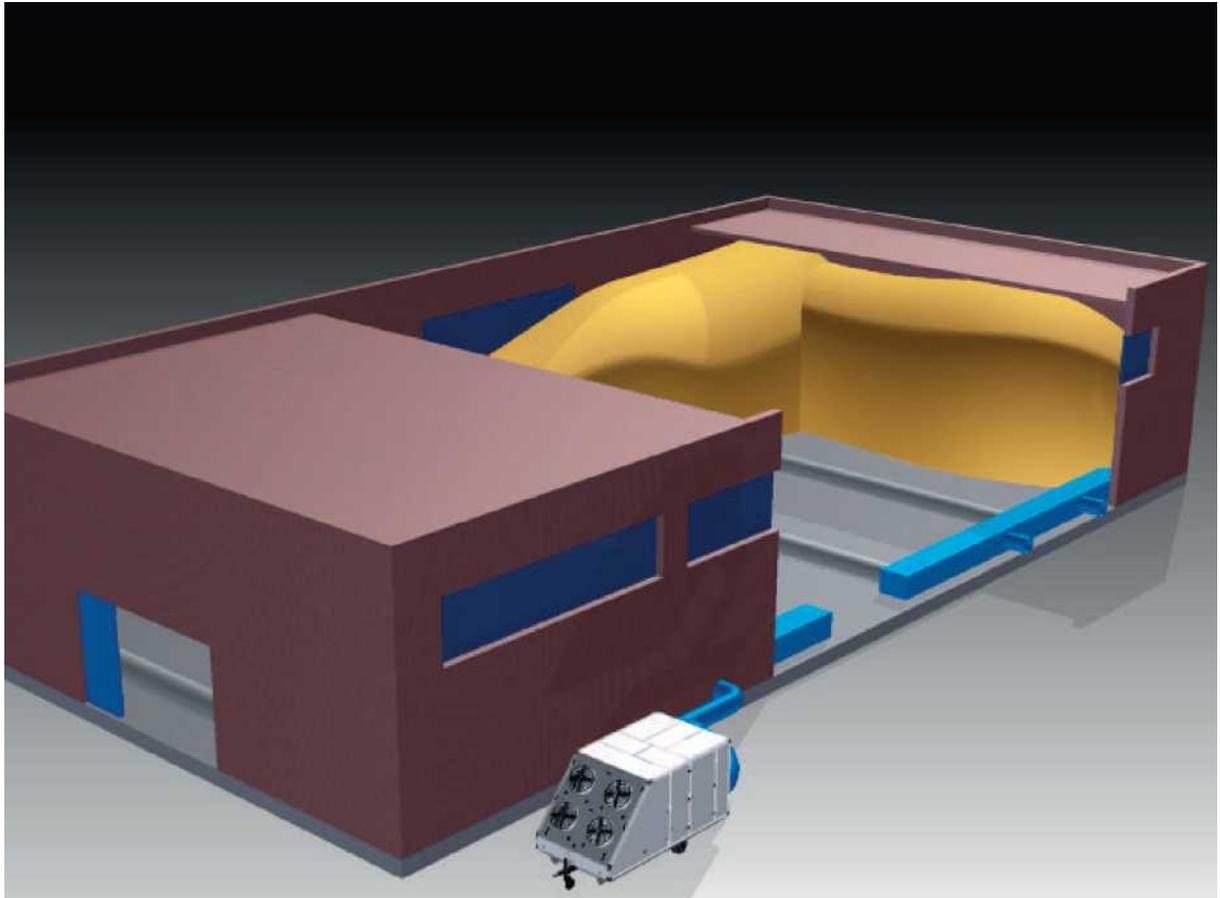
- 6) Reduced weight loss arising from reduced breathing activity (with temperature decrease);
- 7) Conservation with higher relative humidity;
- 8) Storage and homogenisation of batches with different relative humidity values;
- 9) A higher grain quality for a product conserved better and for longer;
- 10) Does not require the presence of an operator as the cooler manages the refrigeration process independently;
- 11) Maintaining wheat temperature at + 13 °C prevents condensation on the inner walls of silos

**SILOS REFRIGERATION**



Silos refrigeration

**WAREHOUSE REFRIGERATION**



Warehouse refrigeration application through an air distribution/blowing system with perforated semicircular ducts or flat wheeled grilles