



**grain** **TECHNIK**

*Each grain matters*

## **Grain Quality Preservation through Grain Chilling**

October 2023, Ho Chi Minh City

# Who We Are



Grain Technik is an Indian manufacturer of grain chillers.



# Who We Are



We operate from two sites next to the Indian capital New Delhi

# View of the Assembly Workshop



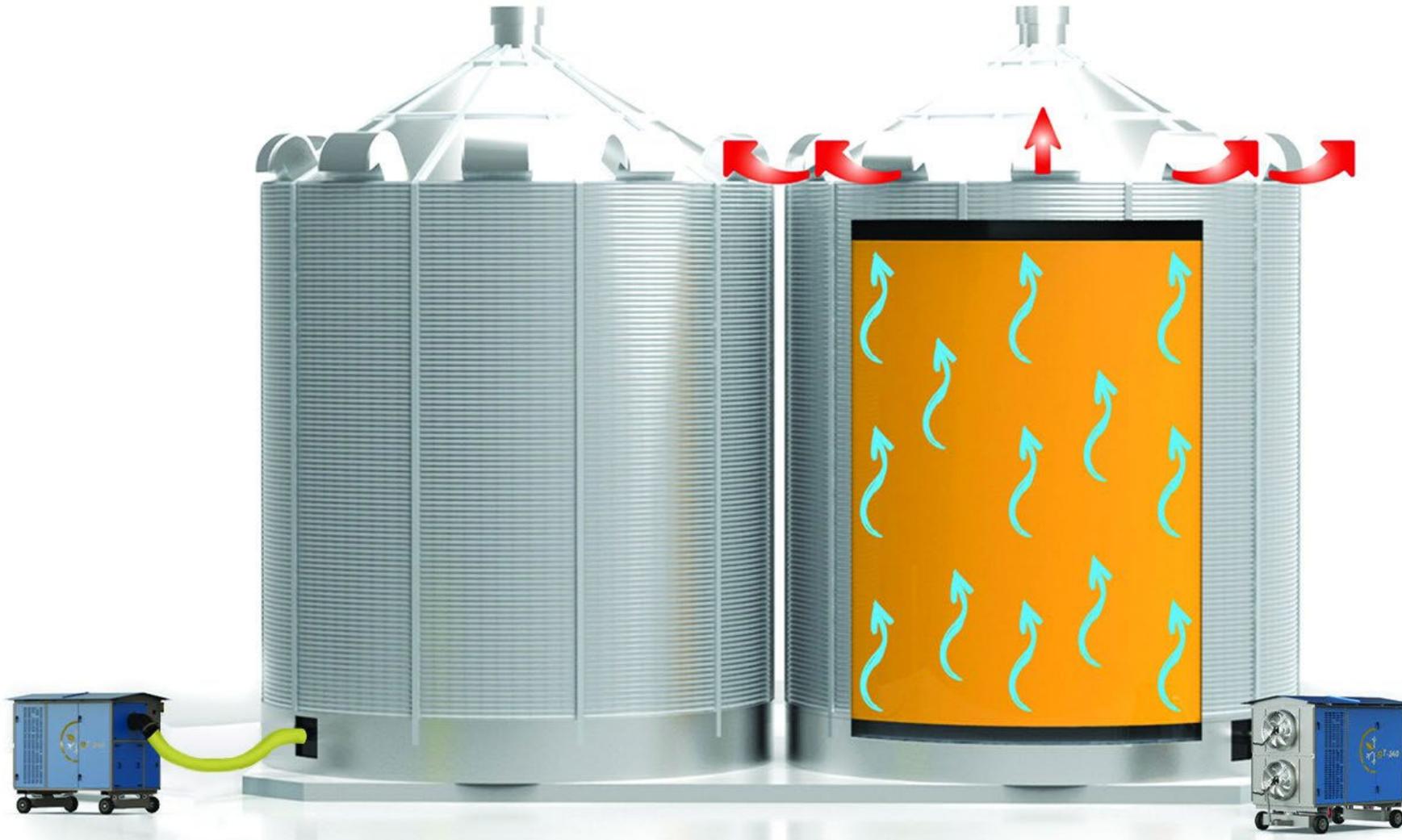
Acceptance test of a grain chiller in our workshop

# View of the Assembly Workshop

Pre-despatch inspection  
of grain chillers



# The Concept of Grain Chilling



- Maintains safe storage conditions at all times
- Precise temperature and relative humidity control
- When the ambient conditions are not suitable for aeration
- Based on the principle of refrigeration

# The Golden Rule of Thumb of Grain Aeration

Relative humidity inside the grain bulk:  $\leq 65\%$



## **Aeration possible when:**

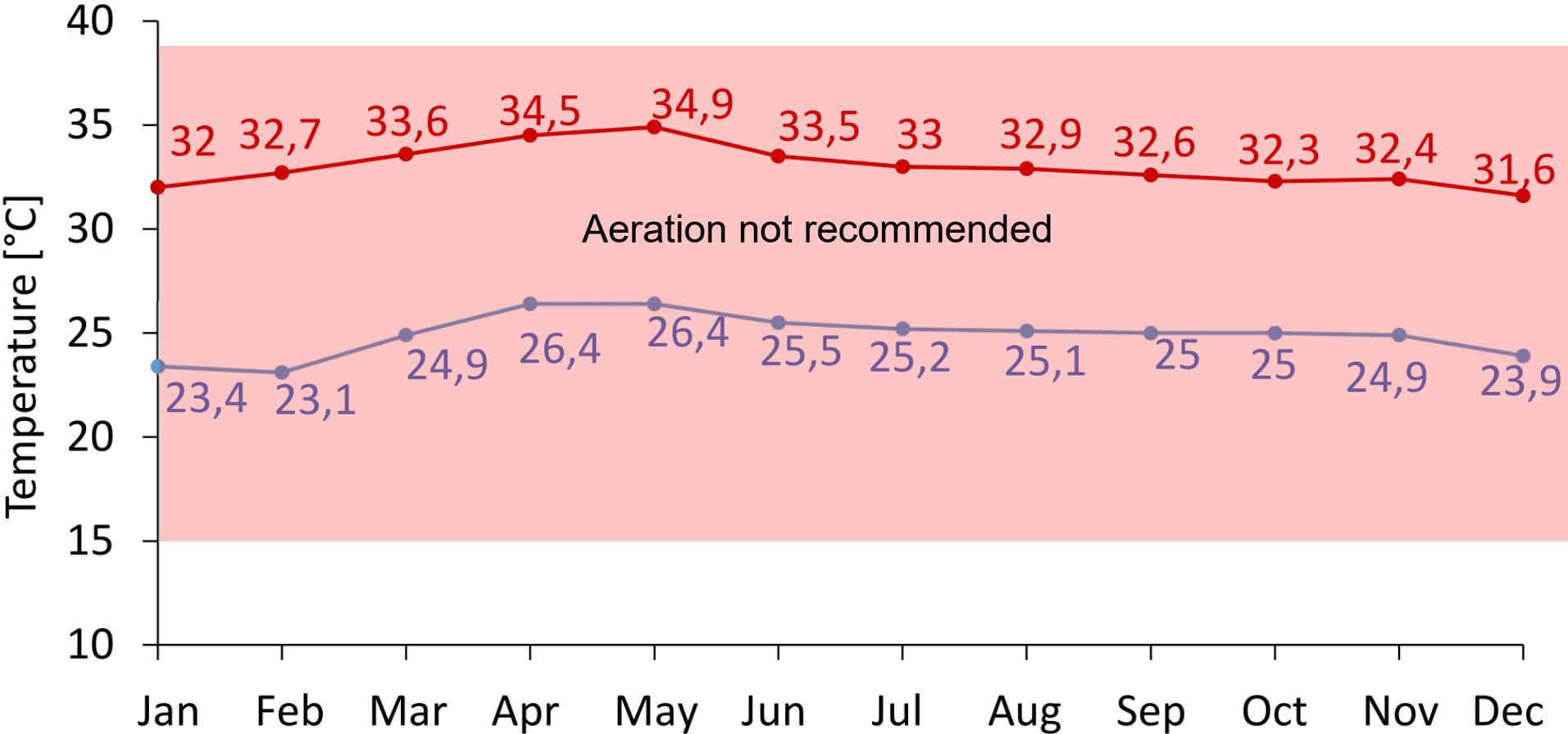
Relative humidity of the ambient air  $< 65\%$

AND(!)

Ambient temperature at least  $5\text{ }^{\circ}\text{C}$  lower than  
the grain temperature

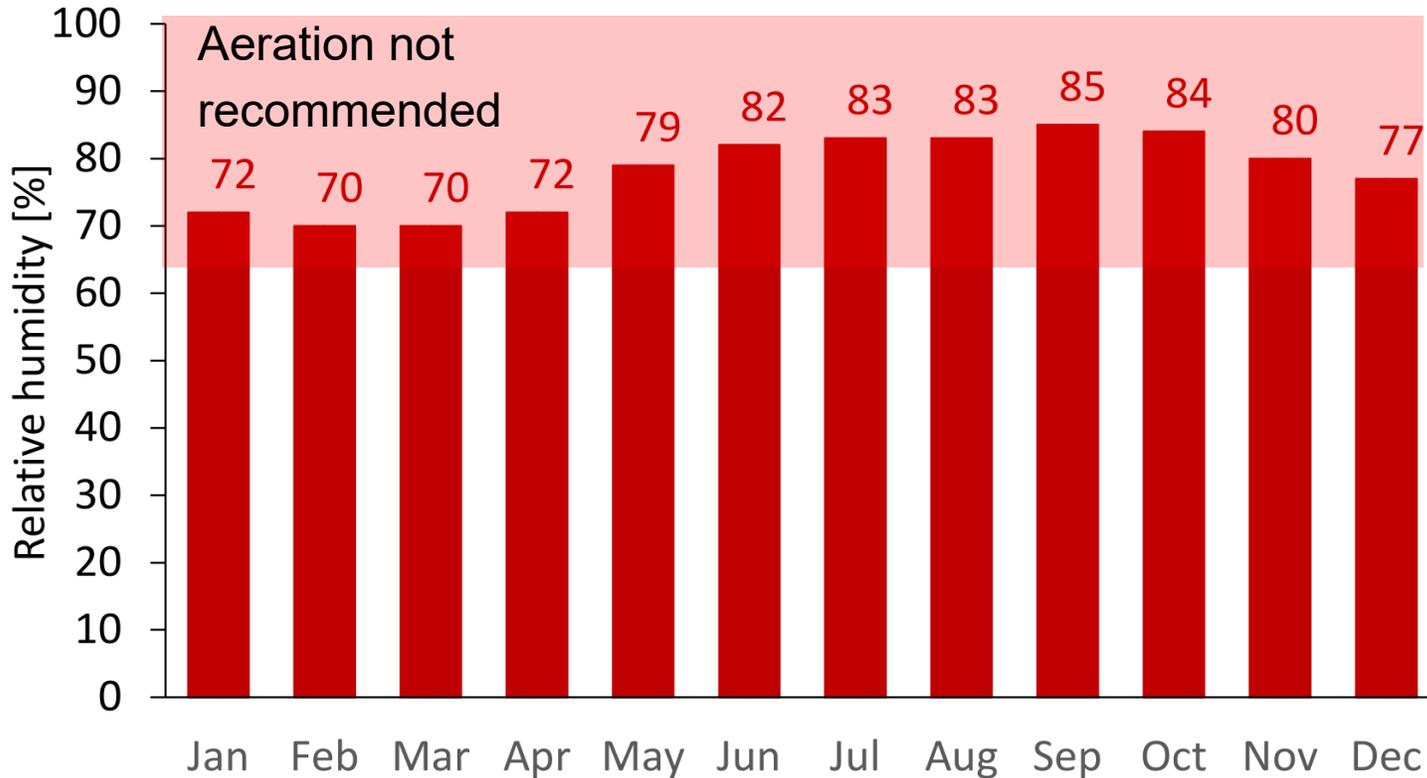


# Monthly average high and low temperatures in Ho Chi Minh City



(With data retrieved from Wikipedia on 25 Sep 2023)

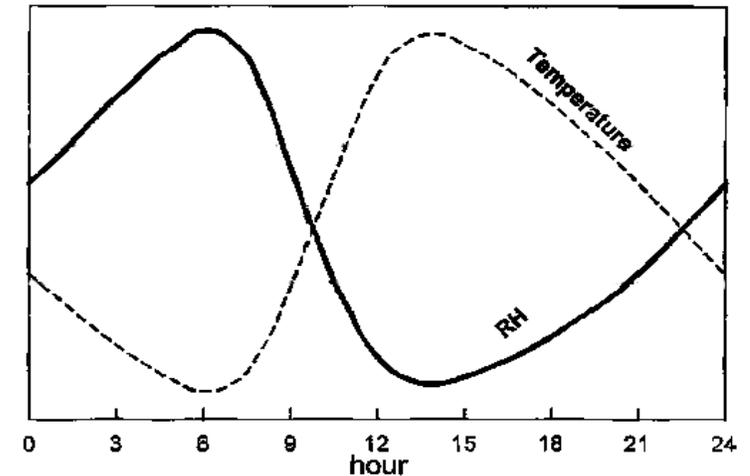
# Monthly average ambient air relative humidity in Ho Chi Minh City



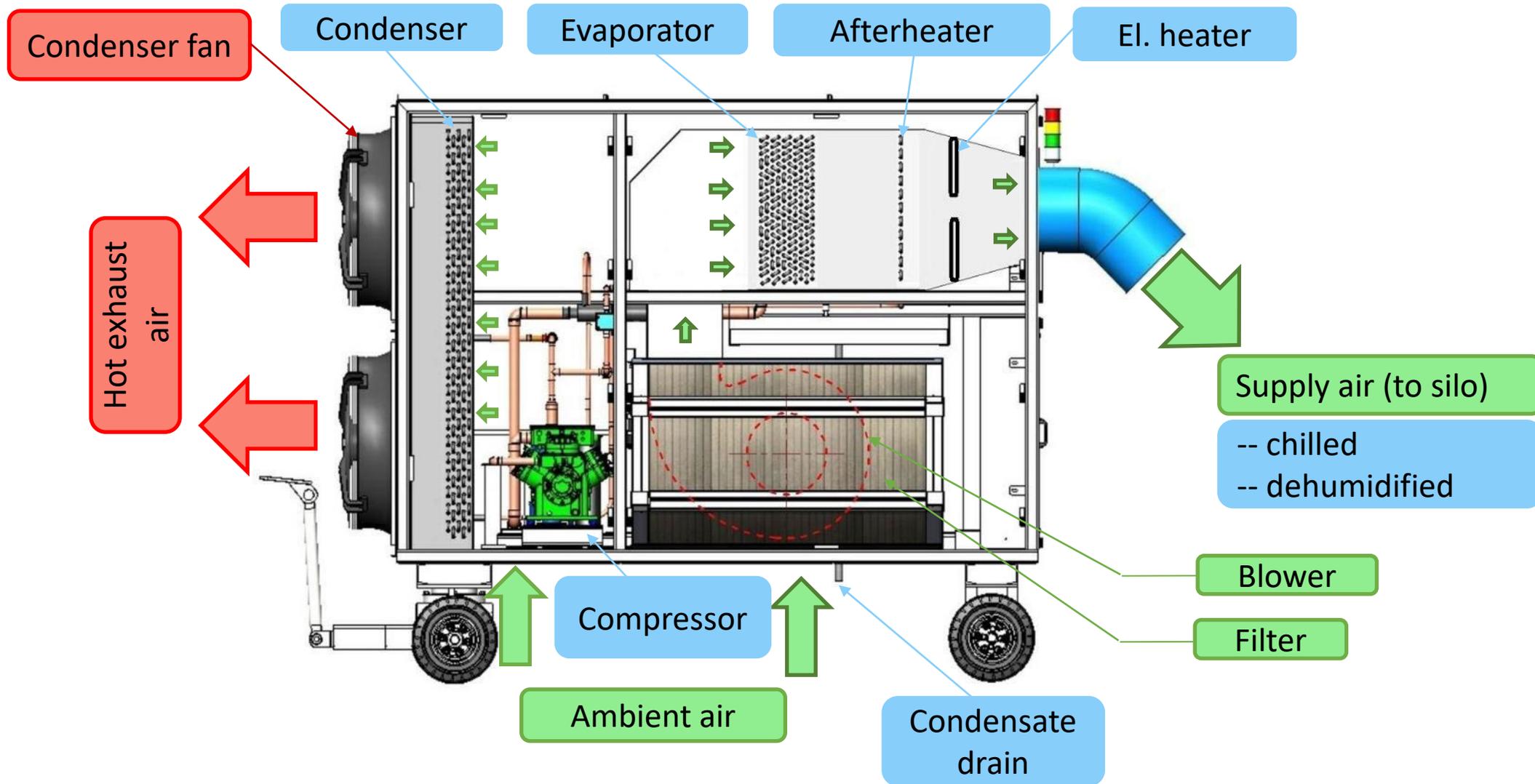
(With data retrieved from Wikipedia on 25 Sep 2023)

But note that the relative humidity varies during the course of the day and tends to rise

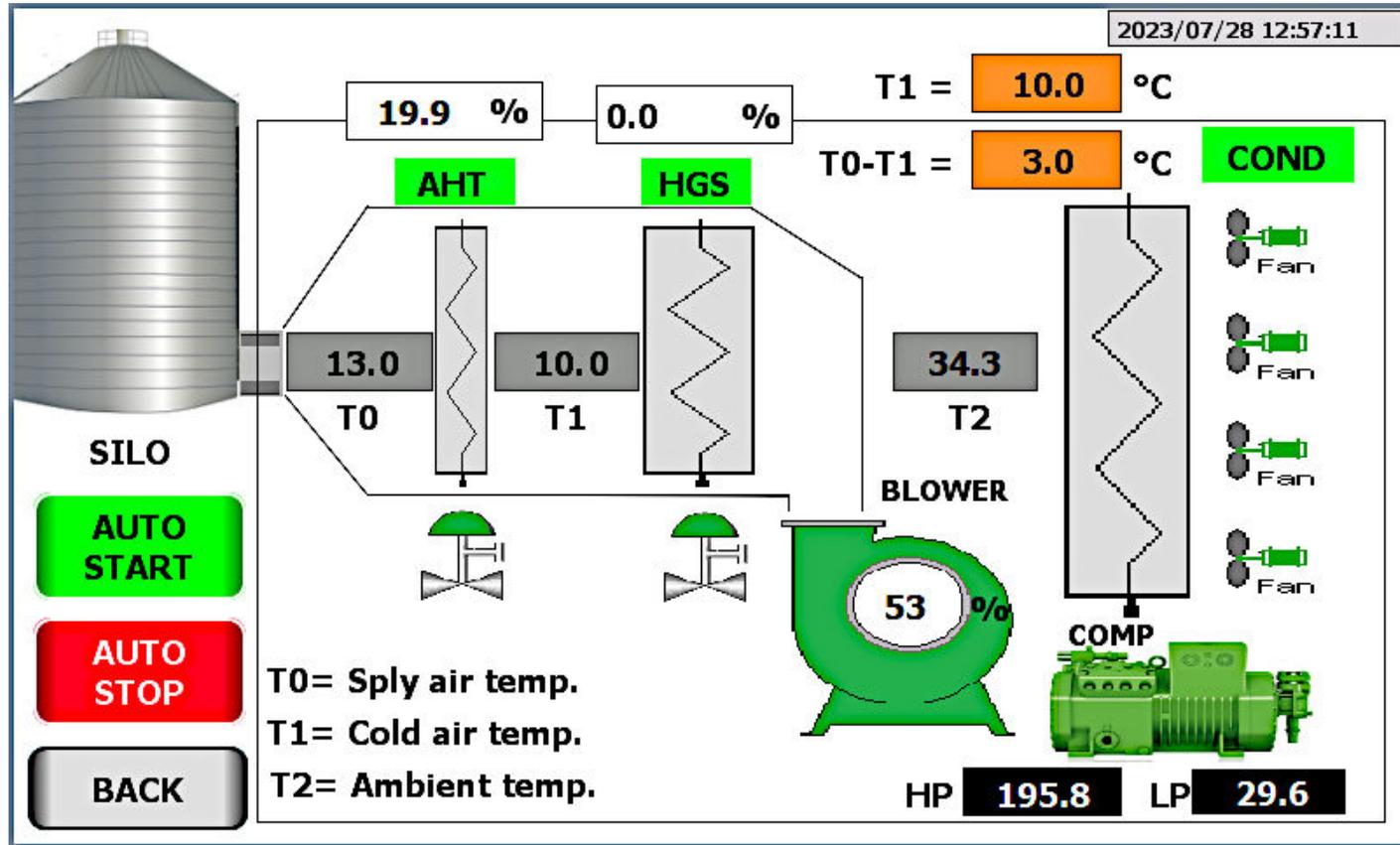
- when the temperature falls
- and, of course, when it rains



# How a Grain Chiller Works



# Automated Operation of the Grain Chiller



A microprocessor controller maintains the required chilled air climate independently of the temperature and humidity of the ambient air

# Chiller Design to Match the Climatic Conditions

## E-Series



## HT-Series



## T-Series



# Chiller Design to Match the Storage Arrangement

Example: T-Series chillers to manage 55 t/d ... 1100 t/d



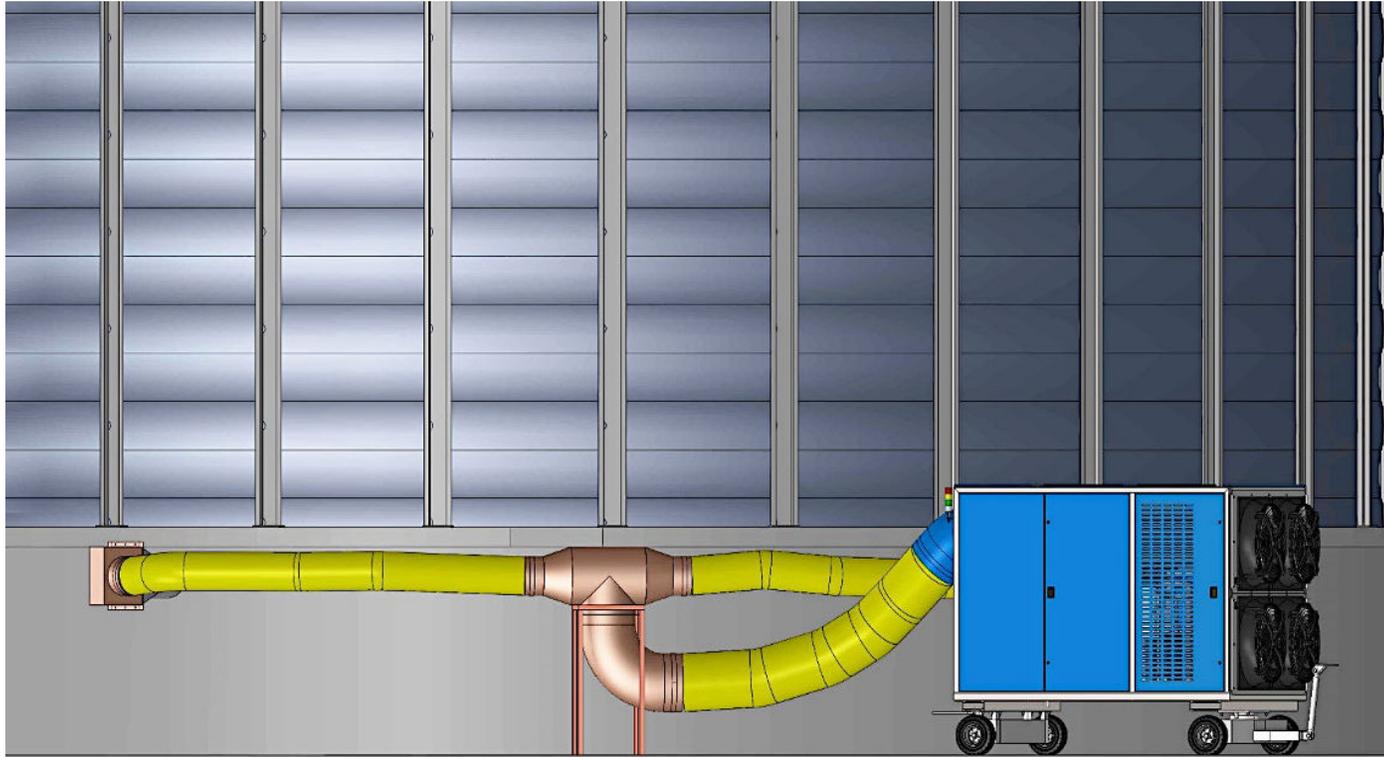
# How to Set Up a Grain Chiller



## Consider:

- Chilled air interface
- Exhaust air handling
- Power supply
- (External sensor)
- (Data communication)

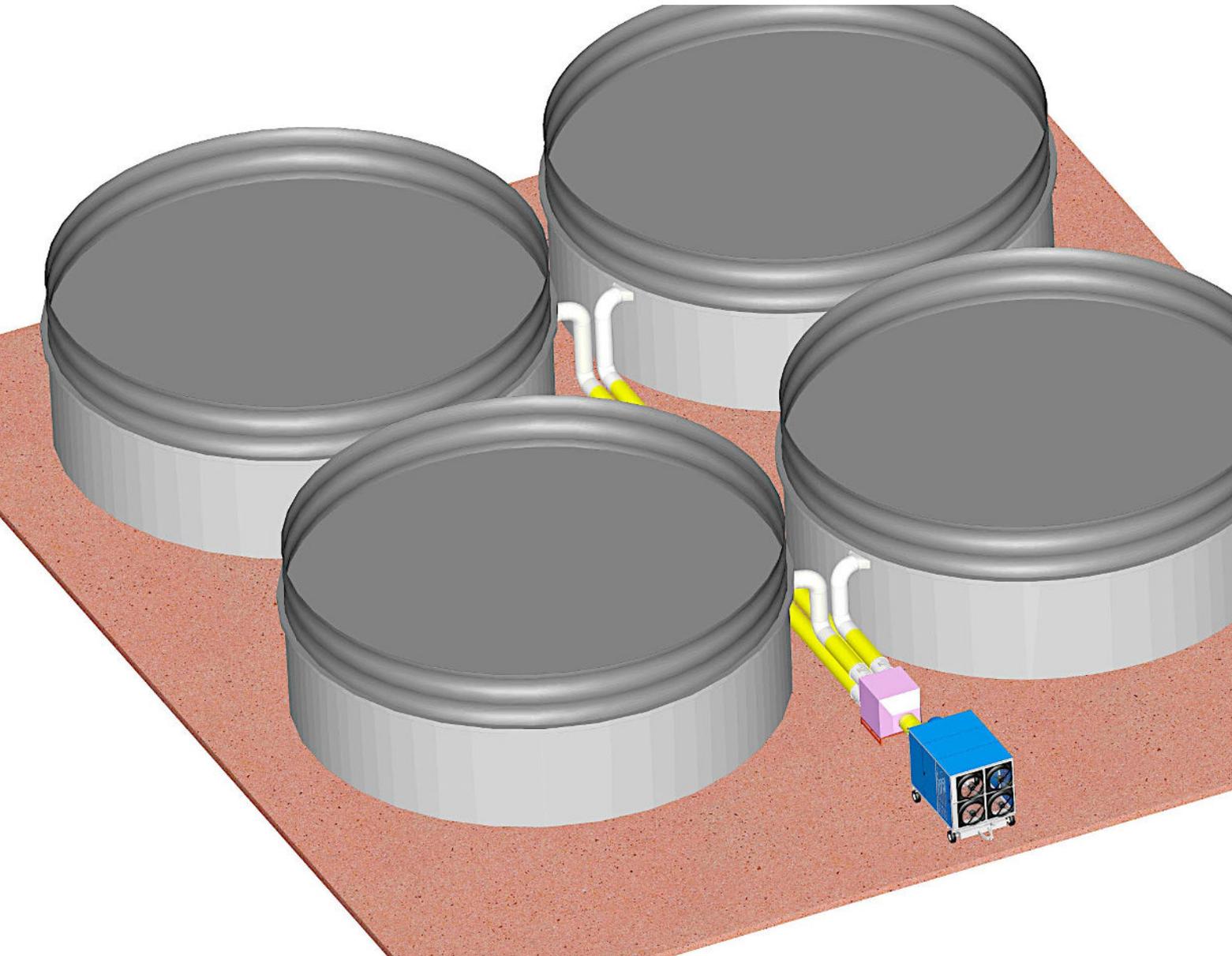
# How to Set Up a Grain Chiller



## Preferred arrangement:

- Flexible duct (hose) to connect the chiller to the distribution duct
- Fixed insulated ducts to transfer the chilled air to the aeration interface(s)
- **As a rule, one chiller serves multiple silos**

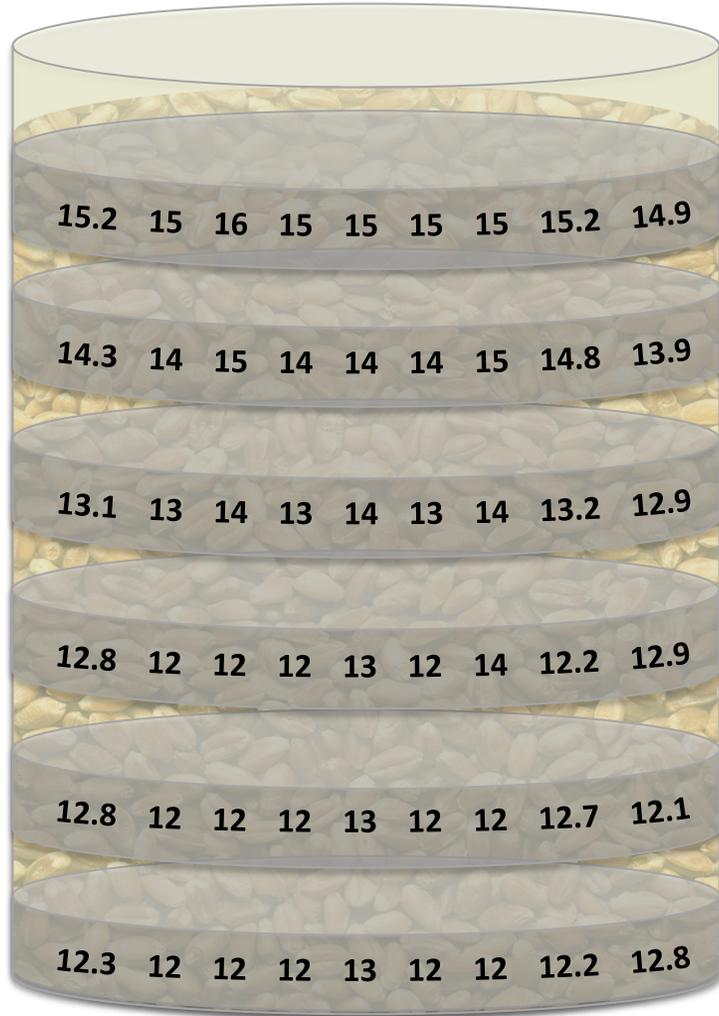
# How to Set Up a Grain Chiller



## Example:

- One grain chiller serves four 3000 t silos
- Stationary chiller
- Air duct arrangement with plenum and adjustable dampers to control the chilled air distribution

# Temperature Gradient in a Chilled Silo



Layer 1

The grain chiller enforces an even temperature distribution in the grain bulk.

Layer 2

At the end of the chilling process, the temperature in the top layer remains a few degrees higher than the bottom layer temperature.

Layer 3

Layer 4

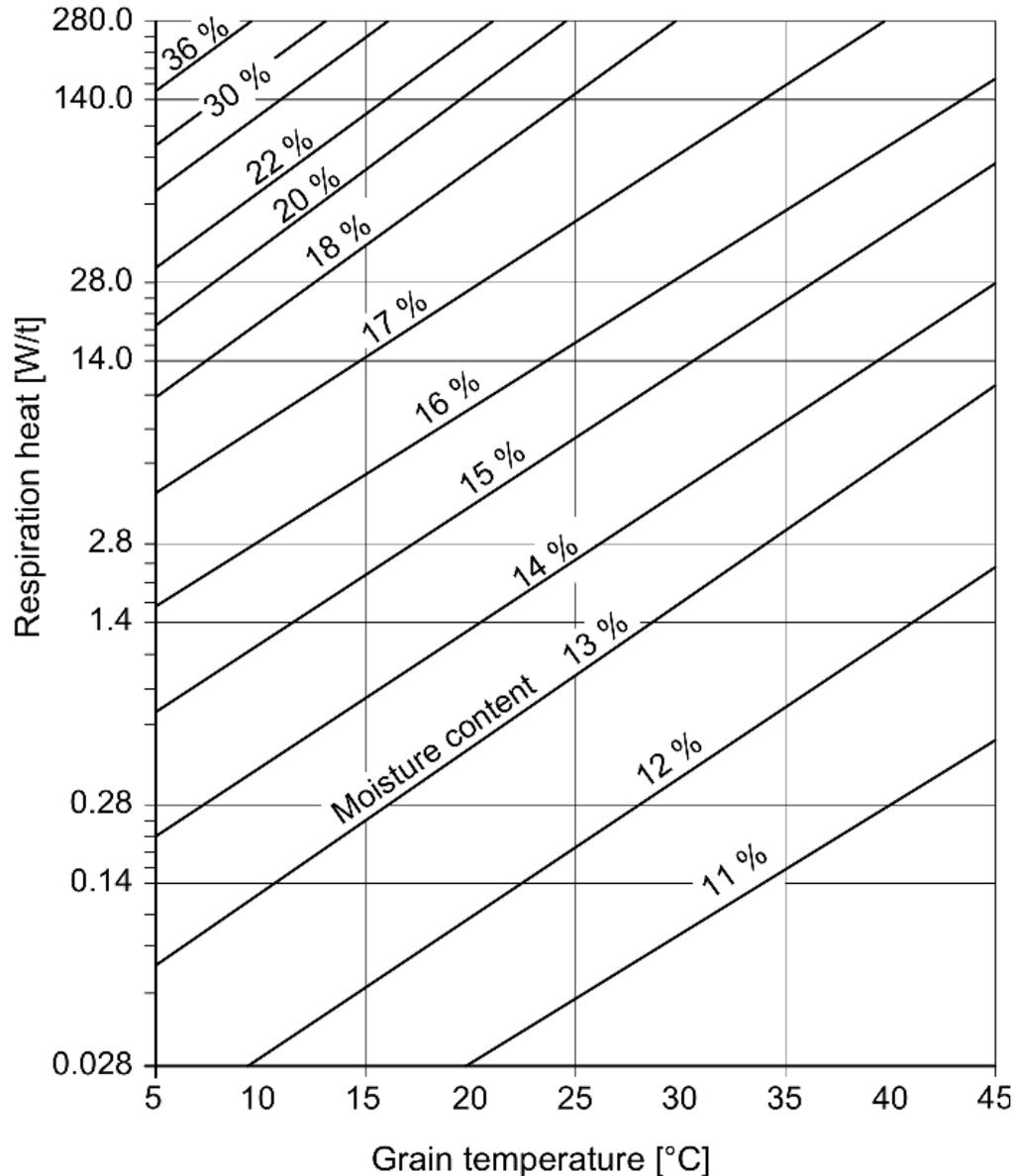
Layer 5

Layer 6

## Results After Chilling (Wheat)

- **No off-odour**
- **Maintains harvest freshness**
- **No discolouration**
- **Higher loaf volume**
- **Improved protein retention**
- **Faster mixing time**

# Moisture Control During Chilling Cycles

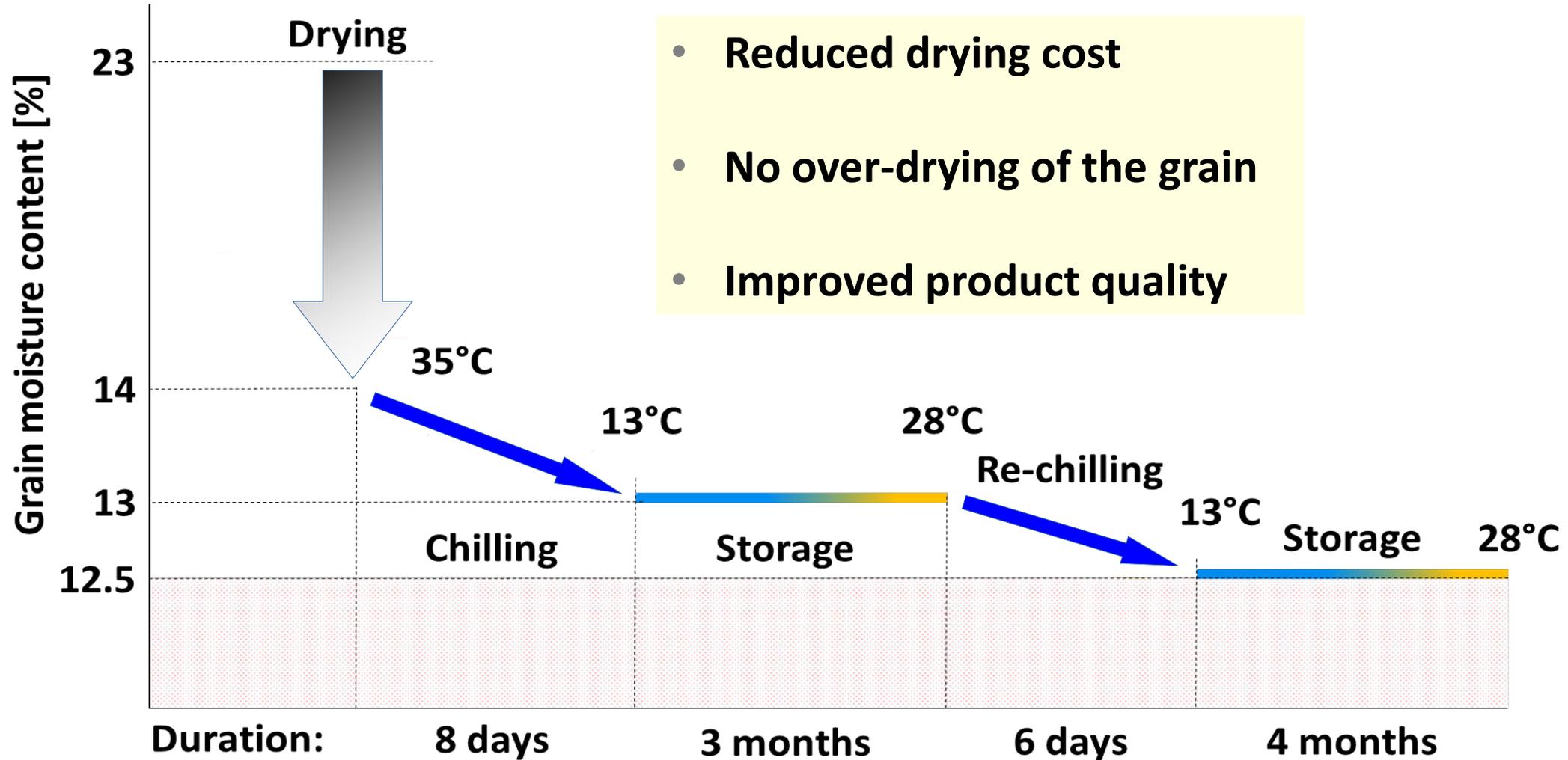


The heat generated in the grain bulk rises sharply when the grain temperature and/or moisture increases.

This can create problems in grain storage silos.

Based on: Skriegan, E. (2008). Technologie der Lagerung und Nacherntebehandlung von Körnerfrüchten: Technology of storing and post-harvest managing of cereal crops. Praxis der Lagerhaltung. Schäfer.

# Moisture Control During Chilling Cycles



# Installations - Wheat

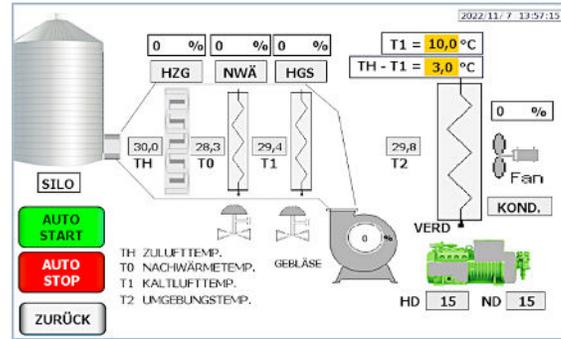


**8 x 8,000t silo**  
**2 x gT-450T**  
**Year: 2020**

# Installations - Multigrain



Flat storage  
1 x gT-180  
Year: 2022

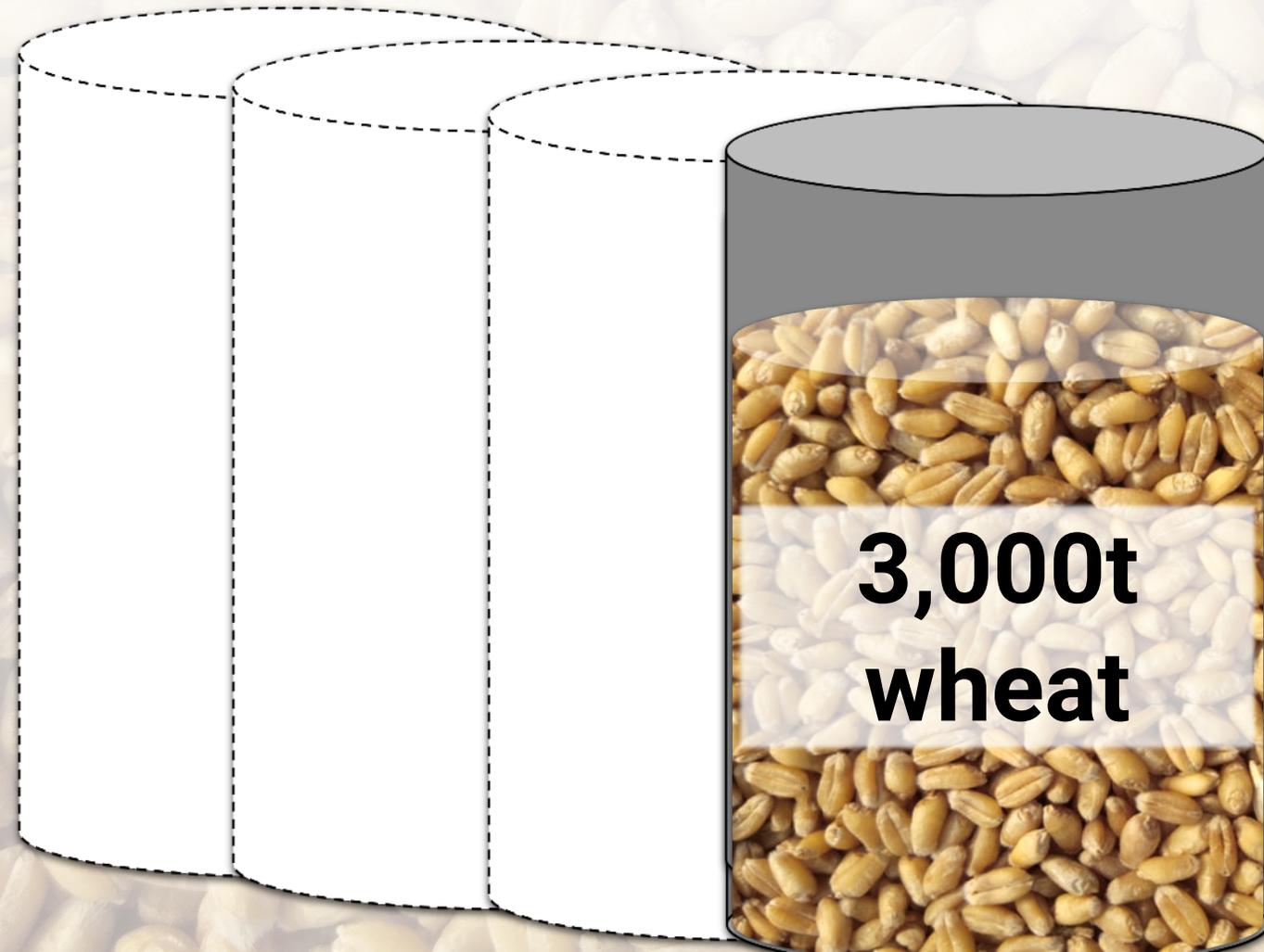


HMI in German  
language

Silo storage  
1 x gT-180  
Year: 2022



# OPEX / ROI Calculation



4 silos of 3,000 t each

Product: Wheat (~300 USD/t)

Storage period: 6 months

Location: Vietnam

1 unit of gT-450T



# OPEX / ROI Calculation

Cost of initial chilling cycle

<b>Total running hours per day</b>	<b>24</b>
<b>Total running hours</b>	<b>168</b>
<b>Avg. power consumption (kW)</b>	<b>72</b>
<b>Total kWh consumed</b>	<b>12,096</b>
<b>Est. power cost (USD/kWh)</b>	<b>0.08</b>
<b>Total running cost for initial chilling (USD)</b>	<b>968</b>



# OPEX / ROI Calculation

Total cost of chilling procedures

<b>No. of times grain to be rechilled</b>	<b>2</b>
<b>No. of days for each rechilling</b>	<b>4</b>
<b>Total number of hours for rechilling</b>	<b>192</b>
<b>Total kWh consumed for rechilling</b>	<b>13,824</b>
<b>Total running cost for rechilling (USD)</b>	<b>1,106</b>
<b>Total grain chilling cost (USD)</b>	<b>2,074</b>



# OPEX / ROI Calculation

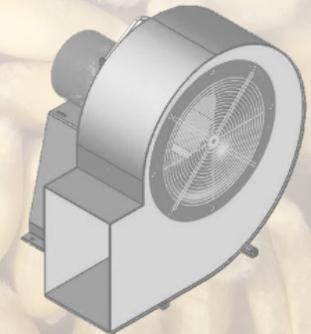


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Each grain matters

## Cost of aeration and fumigation

No. of fumigation cycles if grain chilling is not used	2
Cost of each fumigation cycle (USD)	1,500
<b>Total cost of fumigation (USD)</b>	<b>3,000</b>
Est. aeration running hours per day if grain chiller is not used (h)	6
Est. total aeration running hours if grain chiller is not used (h)	1,080
Total installed aeration fan rating (kW)	15
Total energy consumption for aeration (kWh)	16,200
<b>Est. aeration running cost (USD)</b>	<b>1,296</b>
<b>Total fumigation &amp; aeration cost (USD)</b>	<b>4,296</b>



# OPEX / ROI Calculation

## Comparison

Respiration & other losses @ 4% per silo (USD)	36,000
Number of silos cooled with the machine	4
Total losses (USD)	144,000
Est. grain chiller gT-450T Price (USD)	90,000
Est. ROI for grain chiller	Less than 1 year
OPEX for fumigation & aeration (USD/t)	1.43
OPEX for running grain chiller (USD/t)	0.69



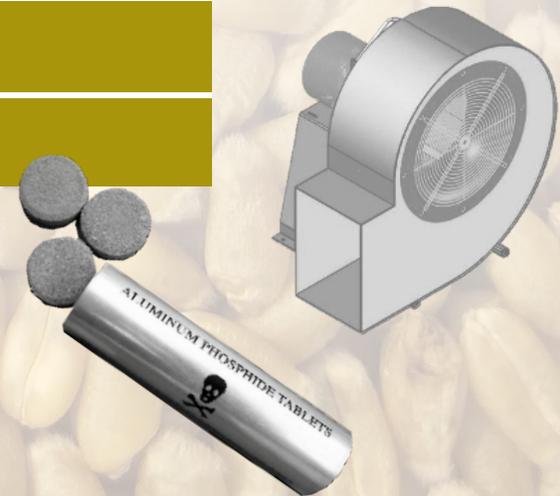
**0.69 USD/t**

vs

**1.43 USD/t**

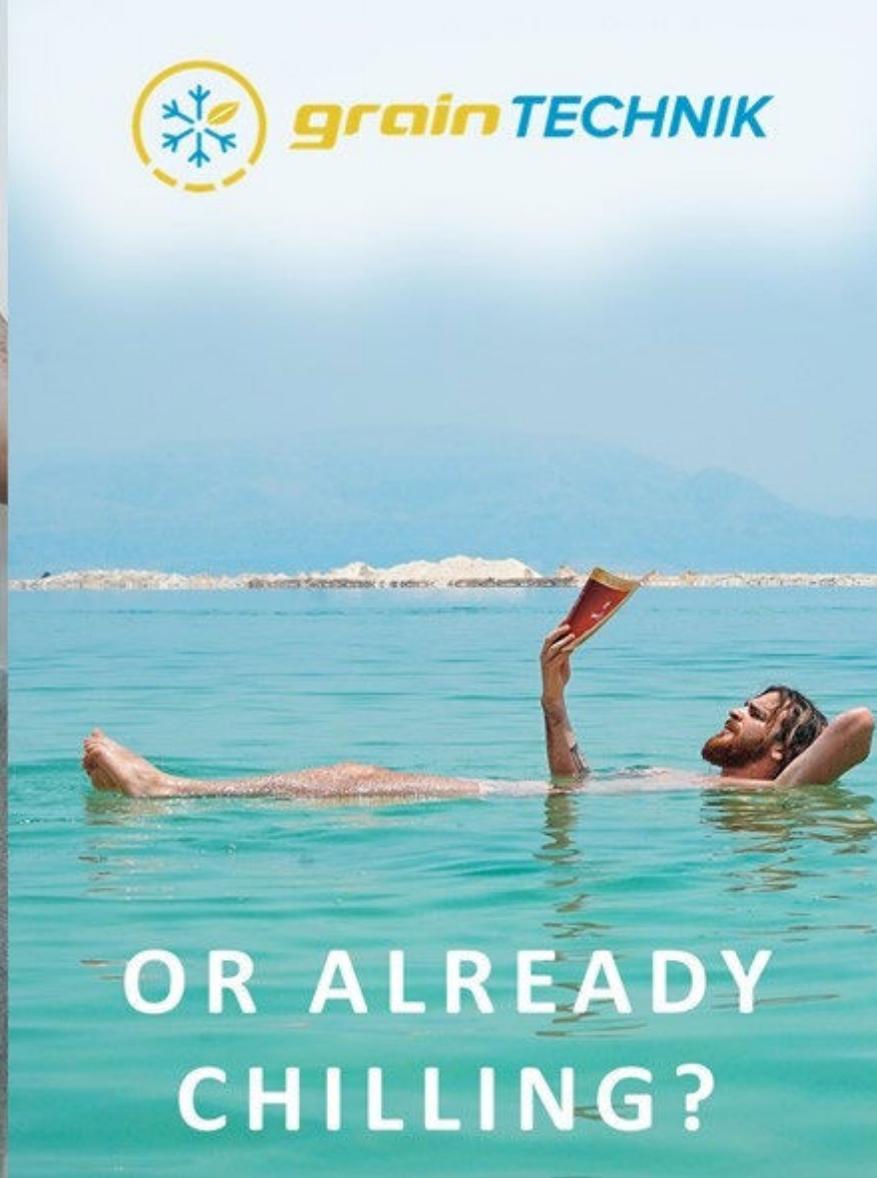


**ROI < 1 year**





**STILL  
WORRYING?**



**OR ALREADY  
CHILLING?**

**Please come and visit us at our desk no. 19.**