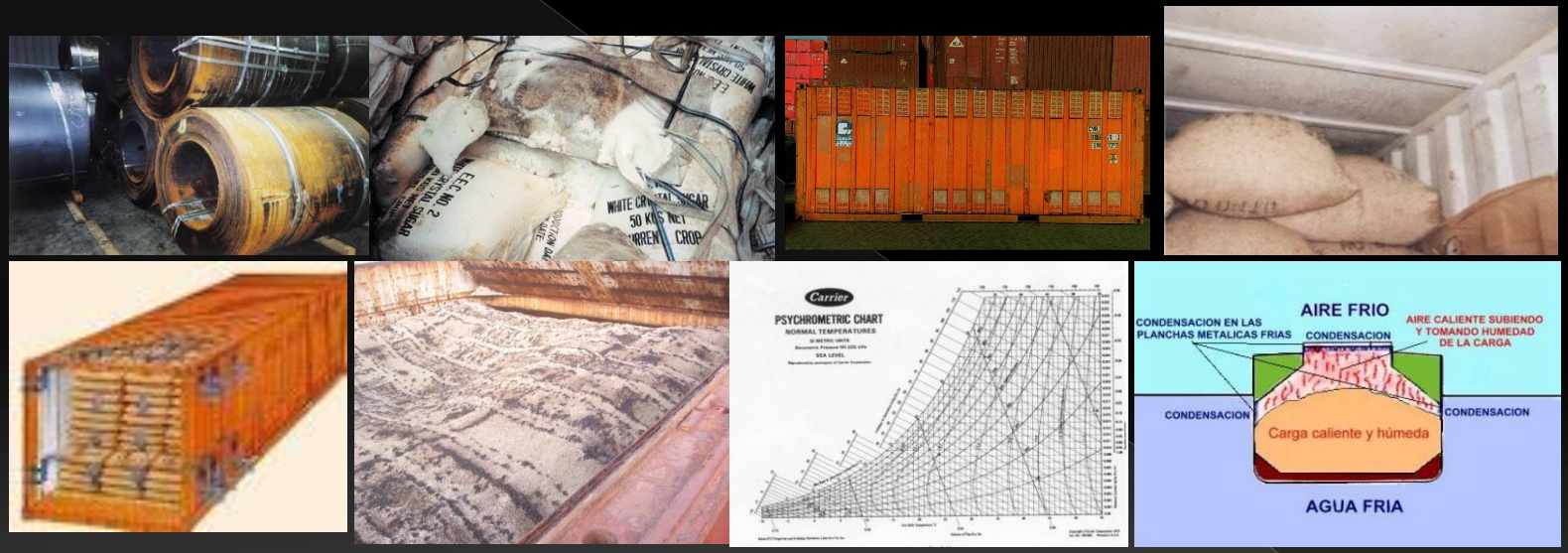
# MARITIME TRANSPORTATION OF GOODS

# UNDERSTANDING CONDENSATION DAMAGE





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# 1.1 OCURRENCE OF CONDENSATION DAMAGE

# UNDERSTANDING CONDENSATION DAMAGE

• Condensation damage during marine transportation of goods is responsible for claims and losses of billions of dollars each year.

• Condensation occurs both in ship holds and in dry containers affecting goods carried at ambient temperature. Sometimes, it is confused with wetting with rainwater or other sources.

Products susceptible to condensation damage:

- Foods of agricultural origin packed in boxes or bags, mainly made of carton, paper, woven polypropylene, jute, sisal or in bulk.

- Metallic products (steel coils, bars, slabs, etc, etc.), metal recipients such as cans, barrels and drums.

## Condensation damage could result in:

- ***Staining of bags and boxes***
- ***Mildew and mold growth***
- ***Odor transfer***
- ***Agglomeration, compactness***
- ***Chemical and microbiological deterioration***
- ***Surface corrosion***


WHITE CRYSTAL SUGAR
50 KGS NET
CROP

# FACTORS AFFECTING CONDENSATION

1. Product moisture content and water activity (to be defined later)
2. Product temperature and air relative humidity when loaded
3. Nature and type of packaging used
4. Presence of substances capable of releasing moisture to the environment (wood pallets, wood, cardboard boxes, paper and other products)
5. Psychrometric characteristics and temperature of air in the ship’s hold or container.

# OCURRENCE

- During transportation significant variations of external ambient temperature and relative humidity can occur that could induce condensation.

- Packaging plays and important role to protect product from condensation. Depending on the package type and material, the product could be protected from wetting with condensation water.

- Cargo can be also protected by using stowage paper, desiccants, heaters, dehumidifiers and appropriate ventilation.

## OCURRENCE

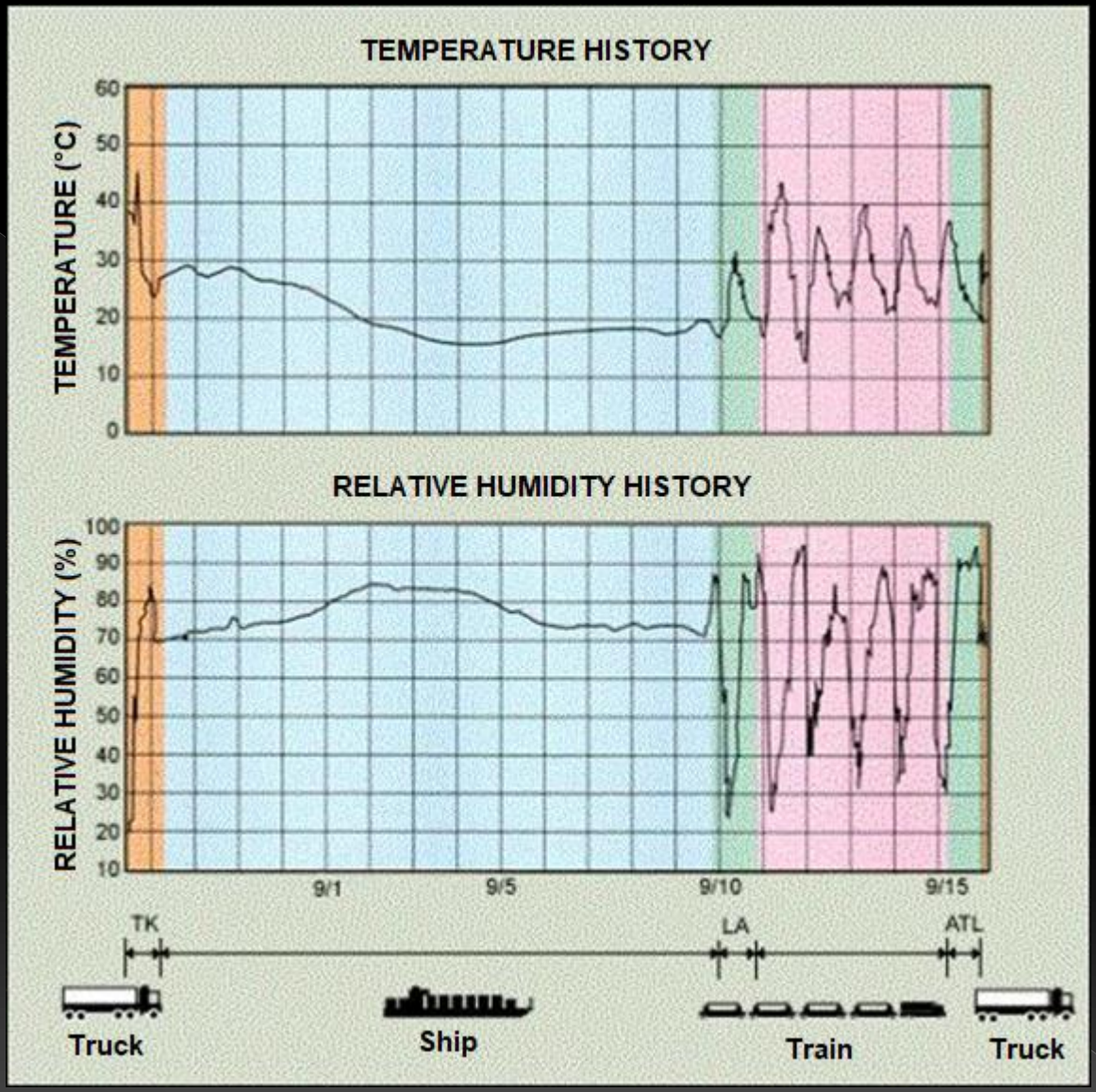
• The largest variations in temperature during transportation of containers take place during land transport.

• Also, in the marine transport of goods from tropical areas to cold zones in winter months (ship's sweat), i.e. cocoa or coffee in bags carried from South America to Europe between December and February.

• Also, cargo loaded in cold zones in winter carried to tropical hot and with elevated air relative humidity (cargo sweat), i.e. malted barley in bags carried from Antwerp to Maracaibo.

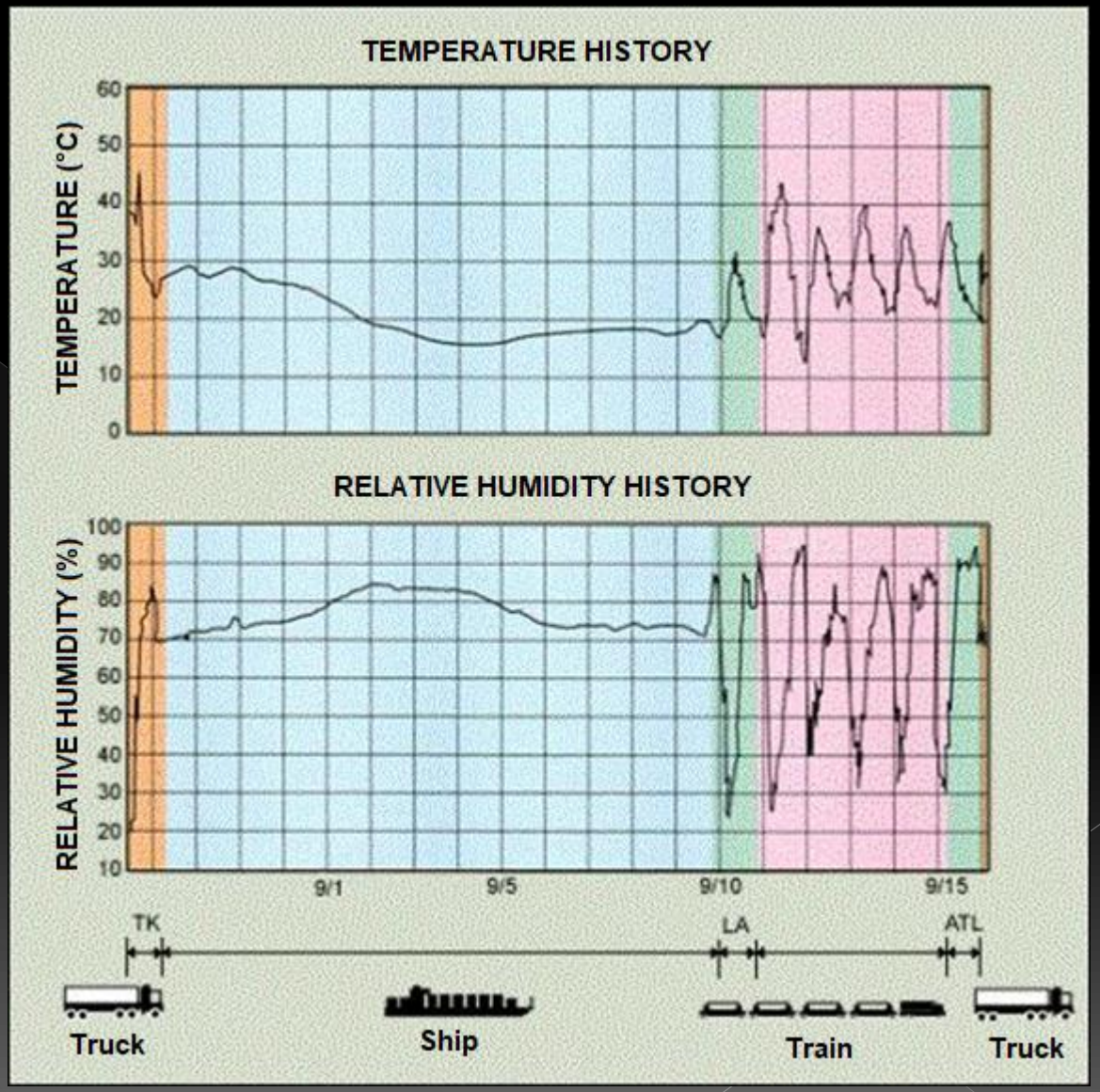
# CASE STUDY

# OCCURRENCE OF CONDENSATION IN A CONTAINER DURING A MULTIMODAL VOYAGE

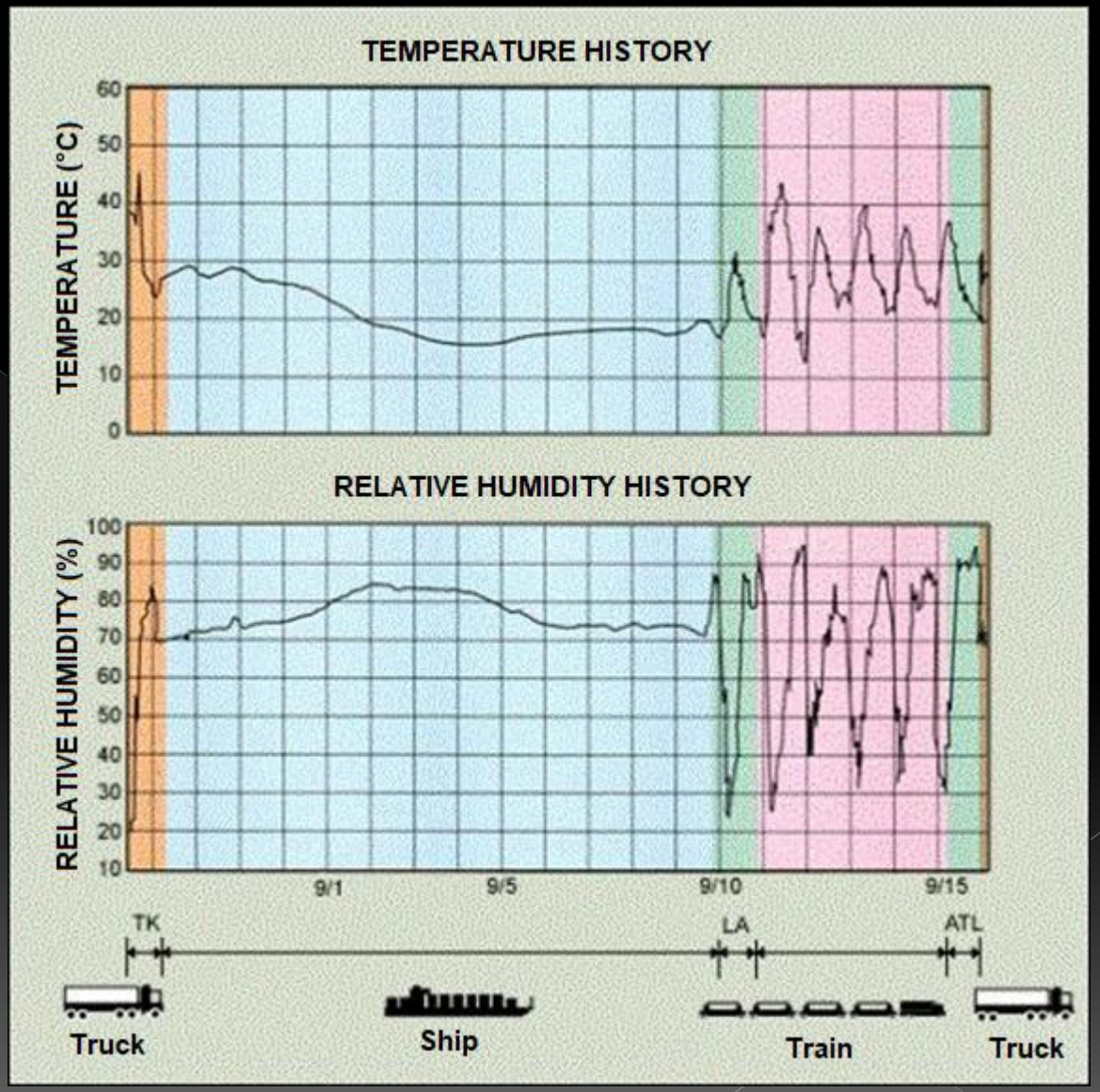



Variations in temperature and air relative humidity in a dry container during a multimodal voyage from Tokyo to Atlanta (USA) showing large variations in temperature and relative humidity (From: NYK Line)

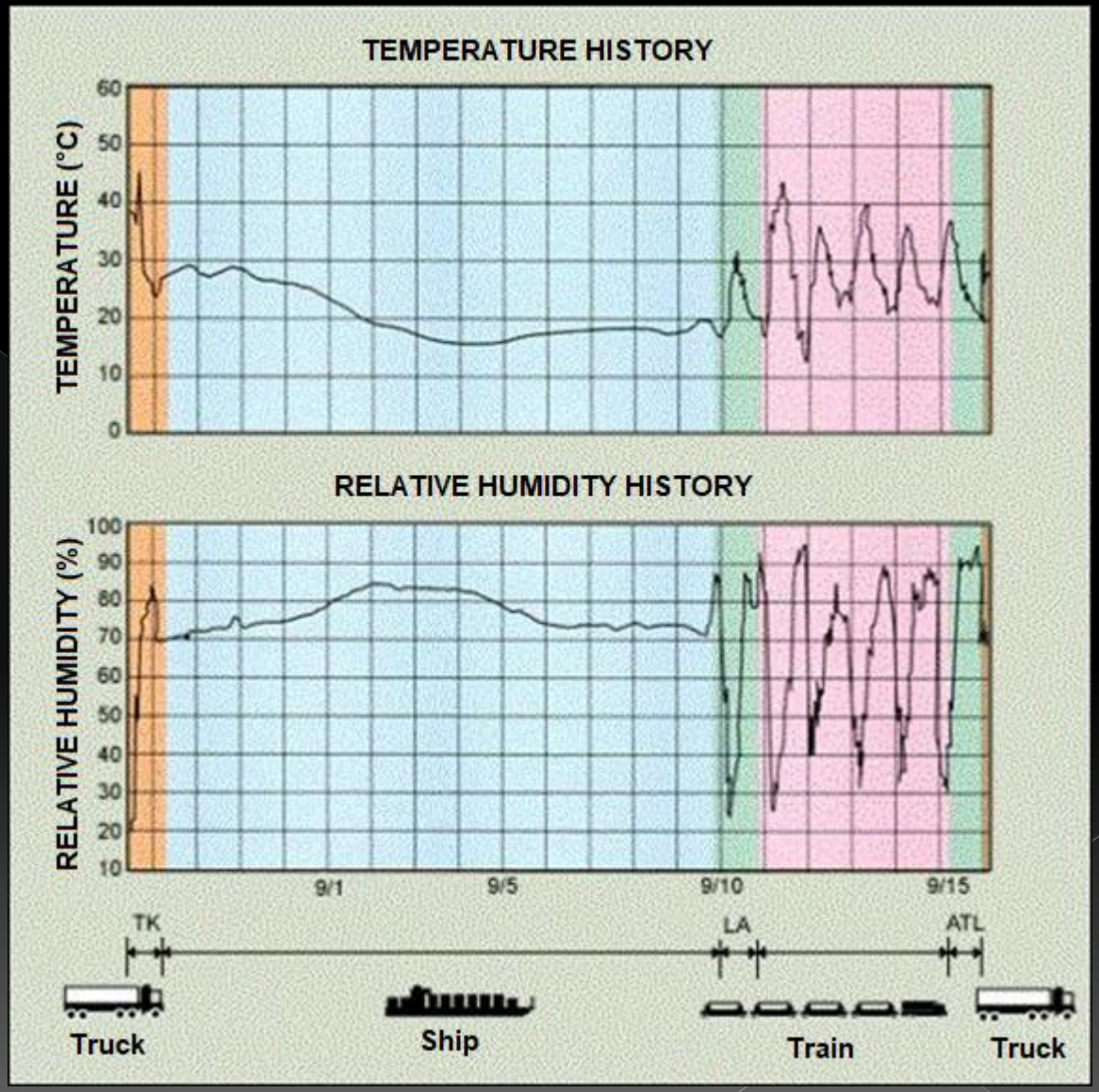
During sea transportation variations in temperature and air relative humidity are gradual (blue zone). If the container is stowed in a hold or on deck with other containers on sides and top, heating by solar radiation is small.



During land transportation (truck and train (orange, green and pink) there are marked fluctuations in daily temperature between day and night (12 to 45 °C). These variations result also in marked variation in air relative humidity in the container (between 25 and 95%) which could induce condensation.



Thus, transfer of moisture from the cargo to the container ambient is produced (if packaging allows) when air relative humidity is low during the daytime. Condensation can take place at night when temperature drops and the air relative humidity rises until reaching its saturation temperature (dew point) and container rain or sweat could take place.



# END OF PRESENTATION

# 1.1 OCURRENCE OF CONDENSATION DAMAGE