

Humidity Management In Cargo Transport

IUMI- Webinar

February 12th 2019

Capt. Uwe-Peter Schieder

Agenda

1 Some questions

2 Water

3 Water content and quality

4 Relative humidity

5 Thresholds

6 Sorption behavior

7 Test voyages

8 Condensation

9 Humidity management

10 Conclusions

11 E-Learning Program

SOME QUESTIONS

Where is the mold growth threshold?

- 1. At 55 % relative humidity**
- 2. At 45% relative humidity**
- 3. At 23.5 ° north or south**
- 4. Or at 75 % relative humidity**

SOME QUESTIONS

Where is the dew point?

- 1. At 15.5 °C**
- 2. At saturation humidity**
- 3. In the early morning**
- 4. At 550 m above ground level**

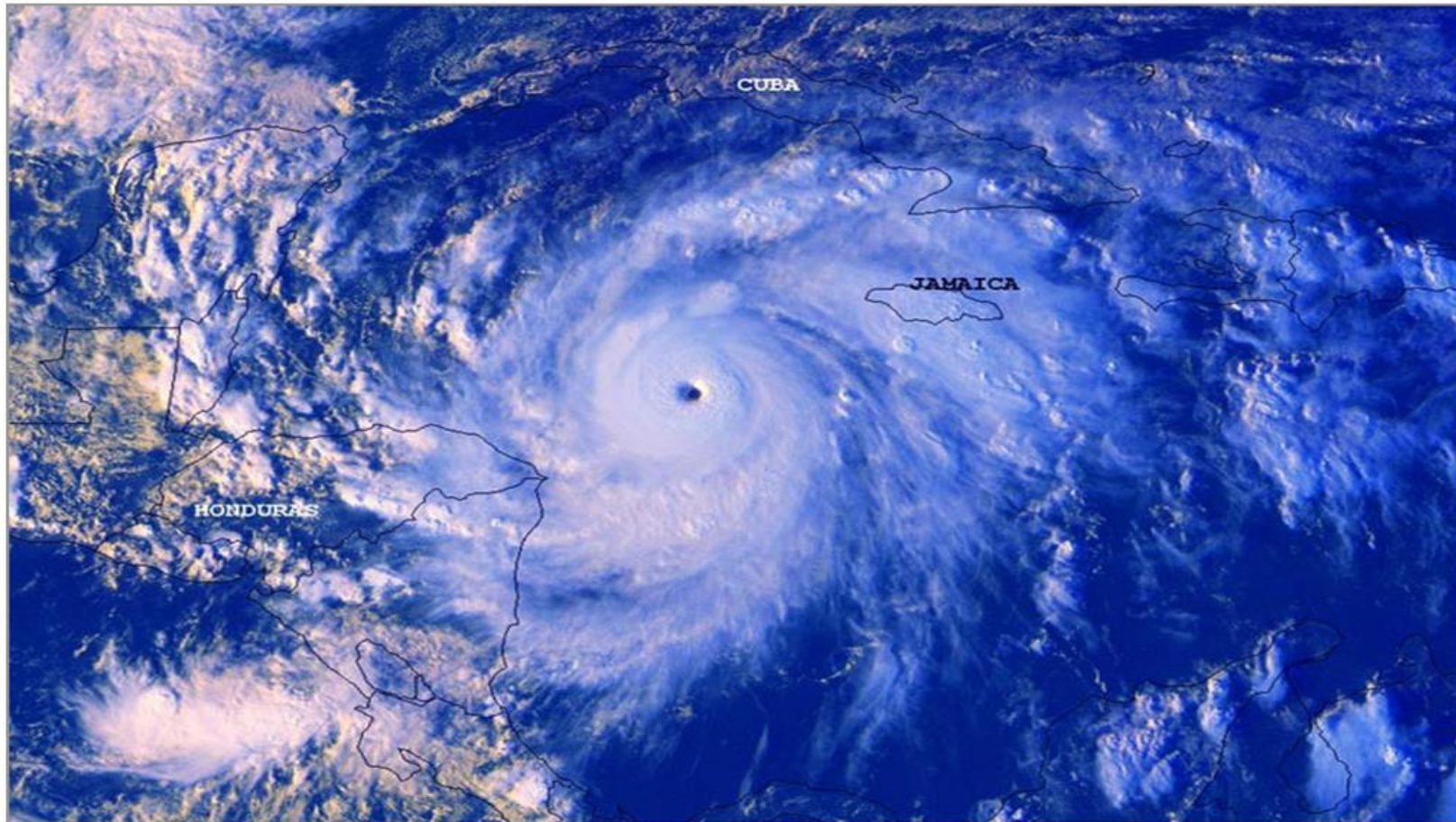
SOME QUESTIONS

How much water is contained in 24 tonnes of green coffee beans that are in a suitable condition for transport?

- 1. $\frac{1}{4}$ of a bathtub**
- 2. $\frac{1}{2}$ a bathtub**
- 3. One bathtub**
- 4. Three bathtubs**
- 5. Eight bathtubs**
- 6. 13 bathtubs**

Water

WATER



Source: Wikipedia

WATER

Aggregate state of water



Foto: Uwe-Peter Schieder / Springmeeting Niagara Falls

WATER

The aggregate states of water



Foto: Uwe-Peter Schieder / Springmeeting Niagara Falls

WATER

The aggregate states of water



Foto: Uwe-Peter Schieder

WATER

The aggregate states of water



WATER

The aggregate states of water



WATER

Liquid



Gas



Water content and quality

Water content and quality



Water content and quality



Water content and quality

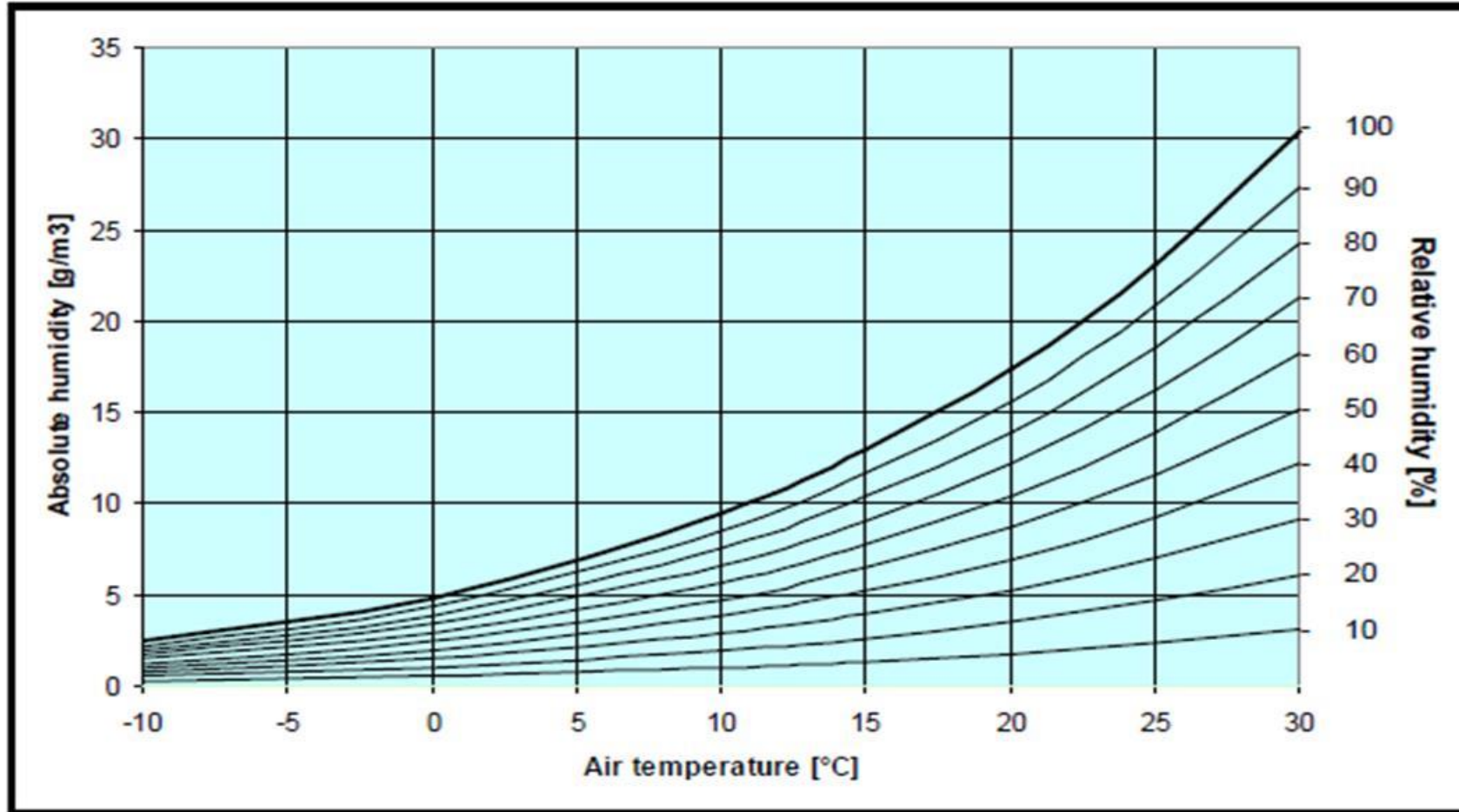


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Relative Humidity Water Vapor Behavior

Relative Humidity / Water Vapor Behavior

Relative humidity

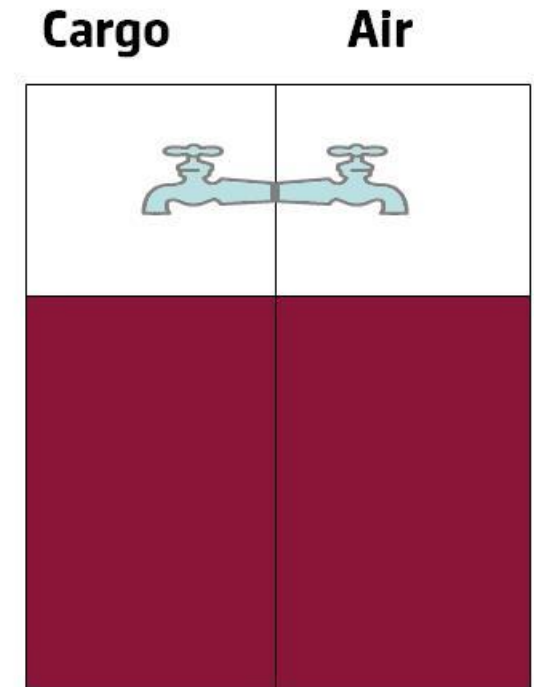
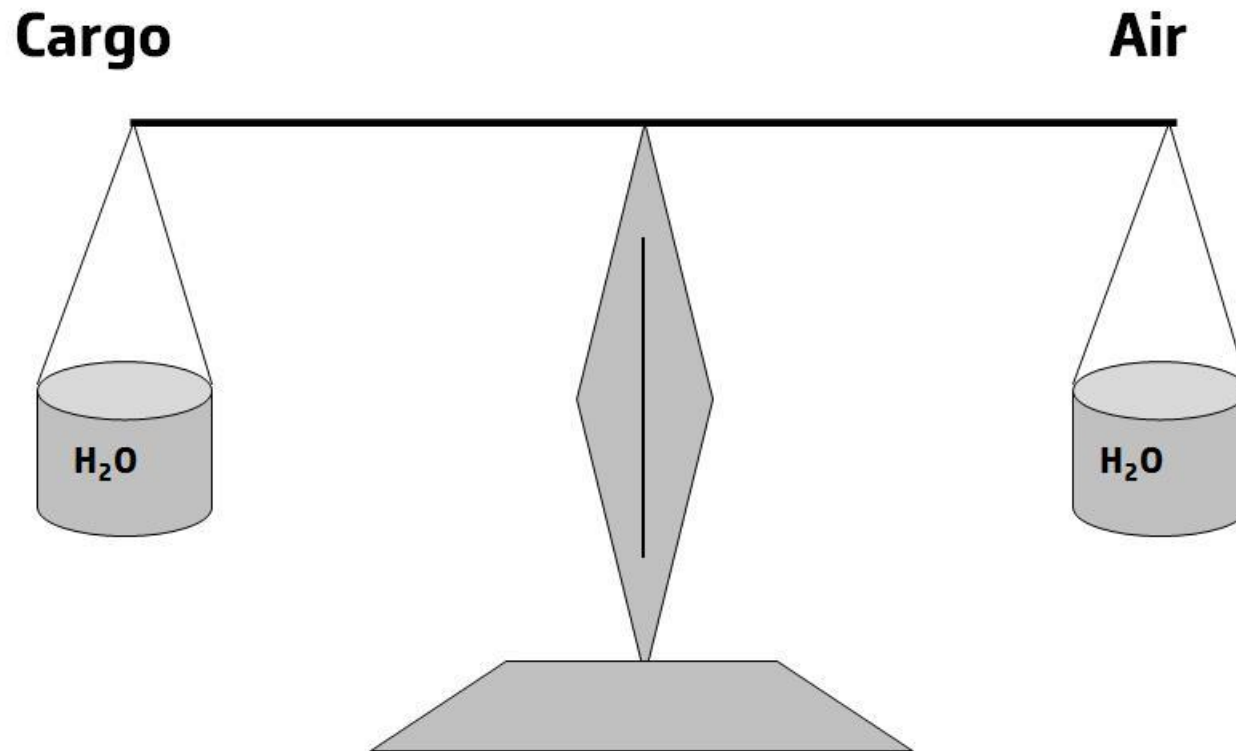


Source: CTU Code

Humidity Management

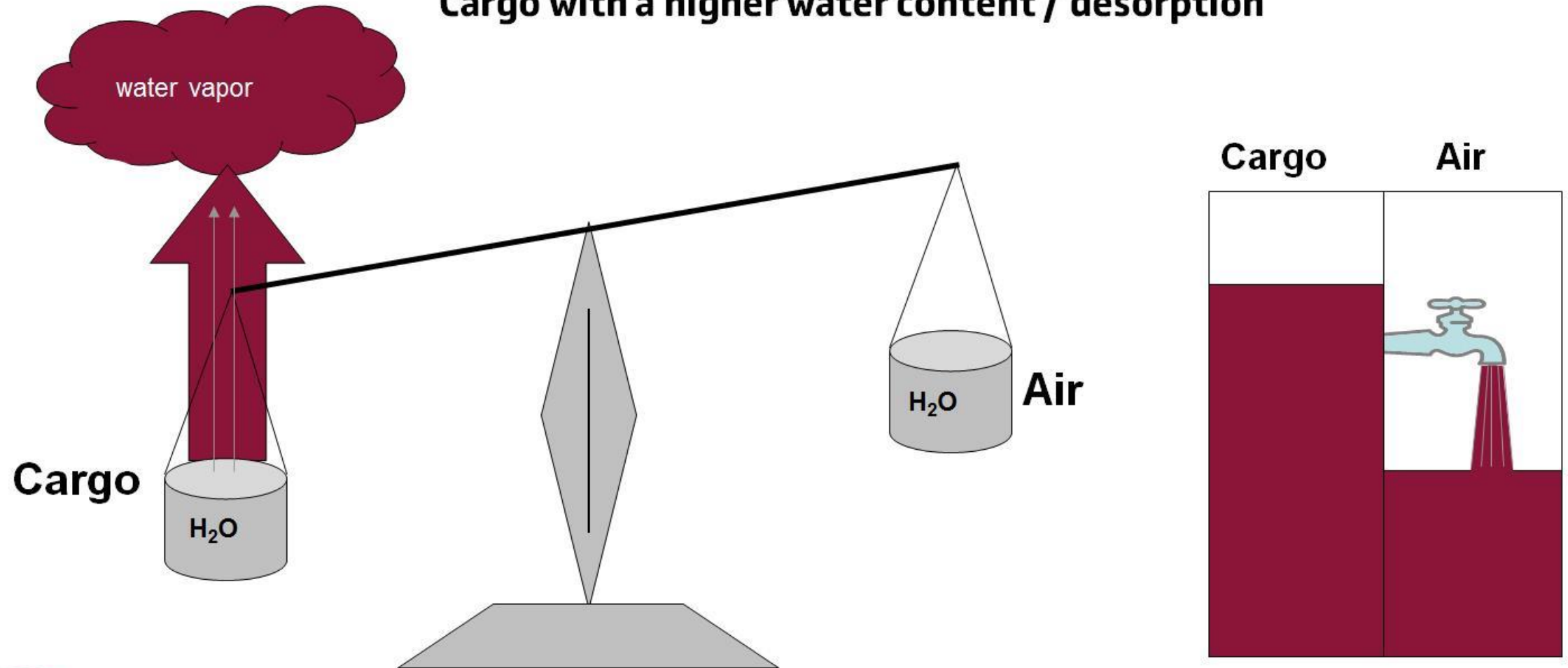
Relative Humidity / Water Vapor Behavior

Water and its behavior in hygroscopic cargo

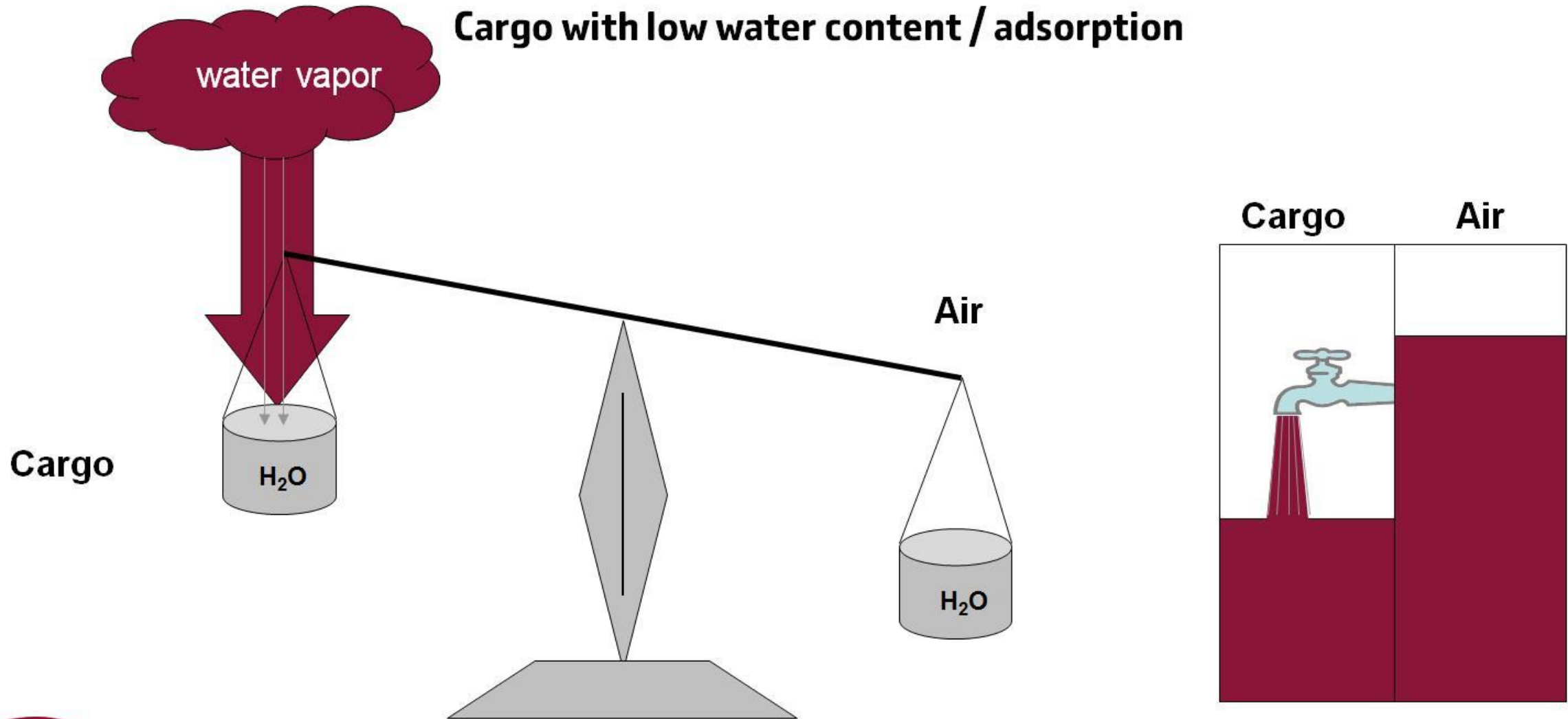


Relative Humidity / Water Vapor Behavior

Cargo with a higher water content / desorption



Relative Humidity / Water Vapor Behavior



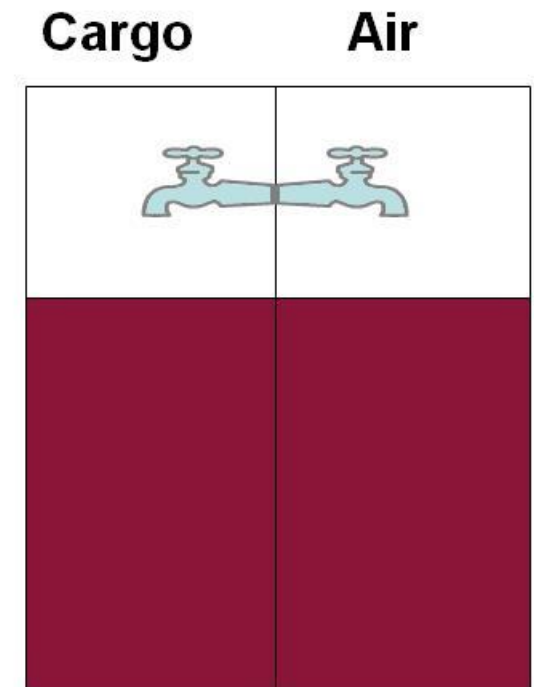
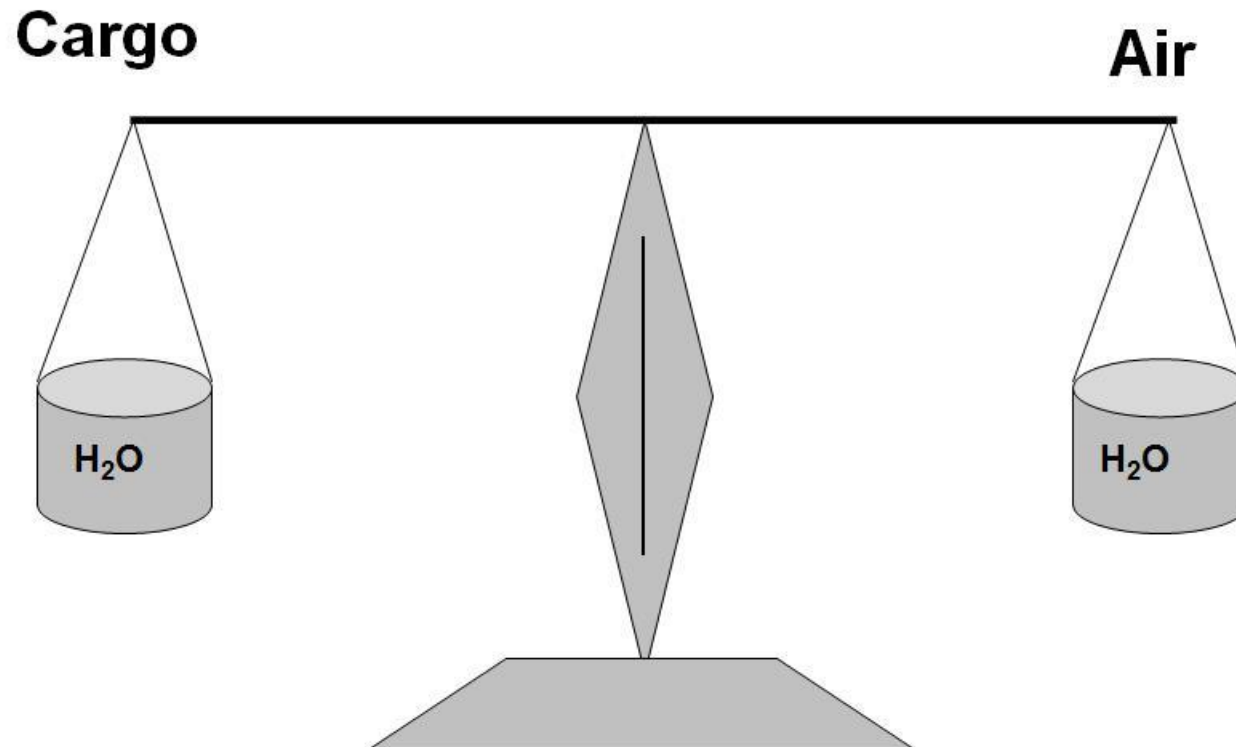
Relative Humidity /Water Vapor Behavior

Water content imbalance



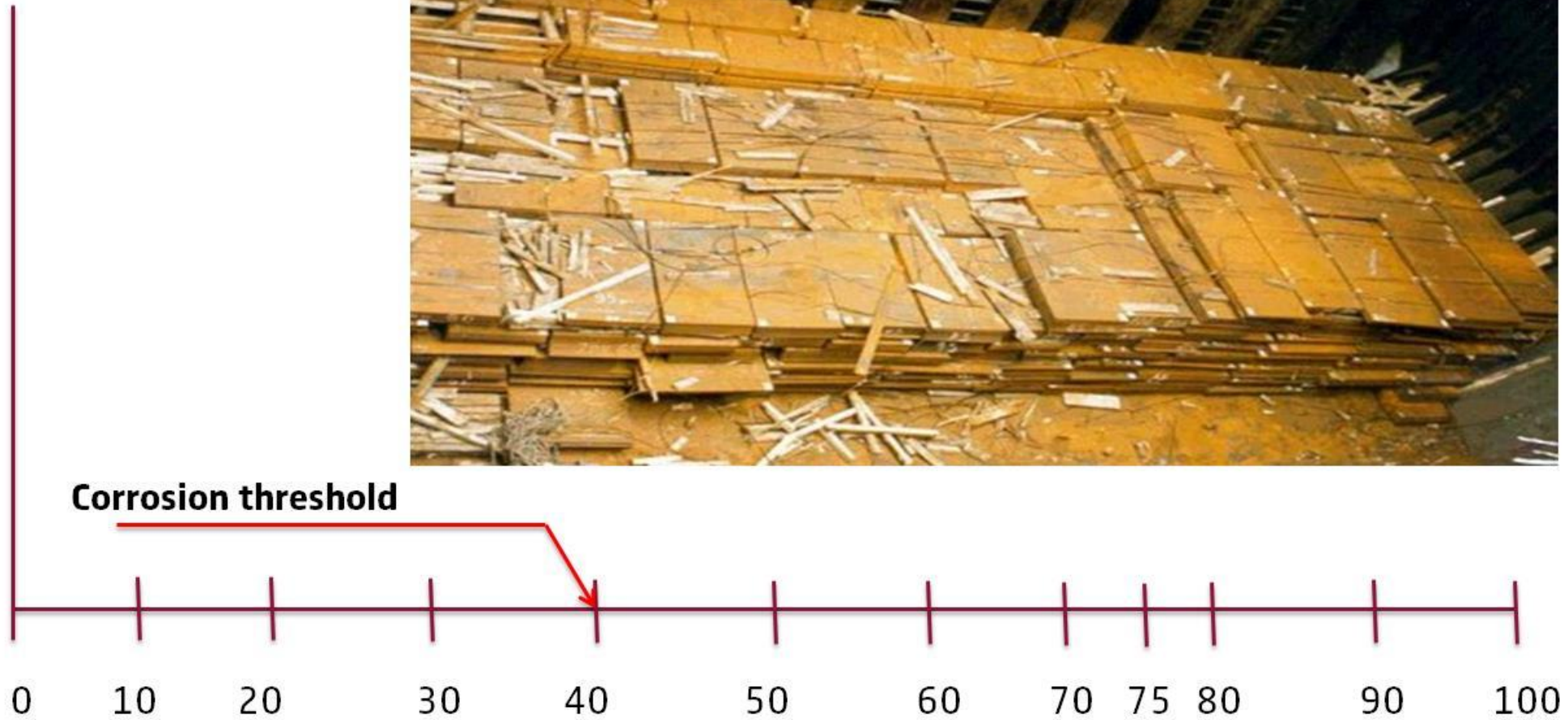
Relative Humidity / Water Vapor Behavior

Equilibrium moisture content

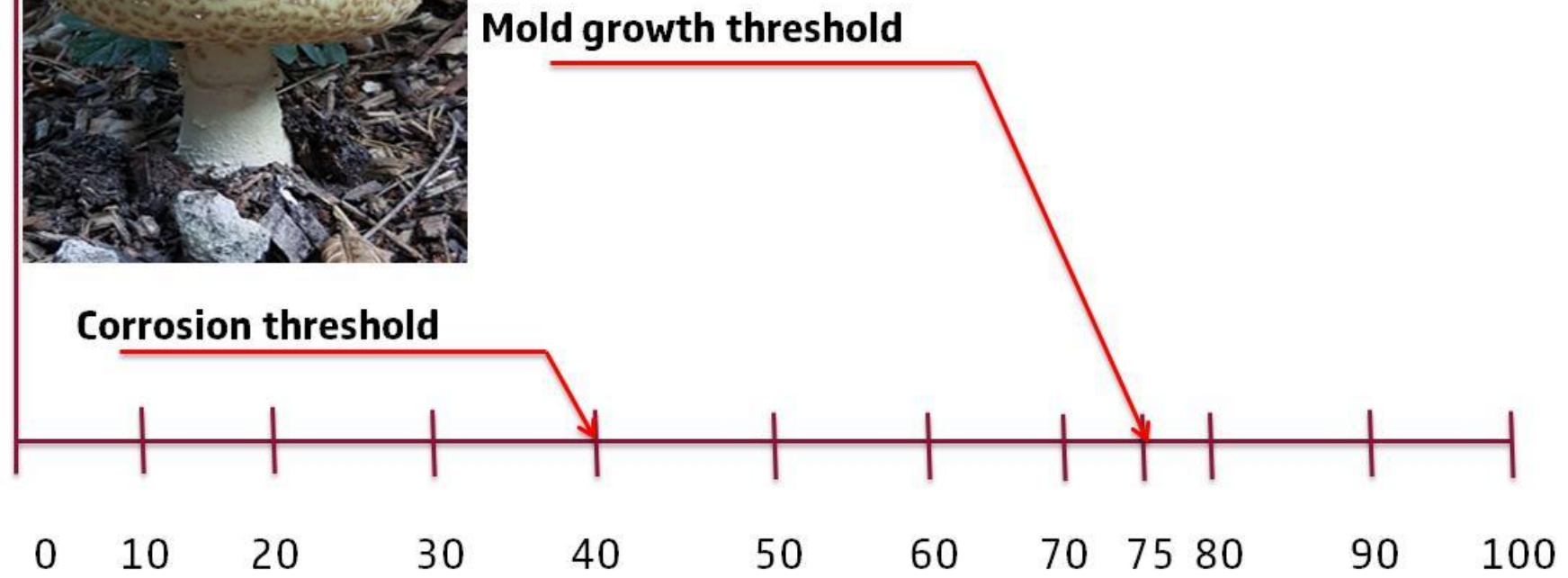


Thresholds

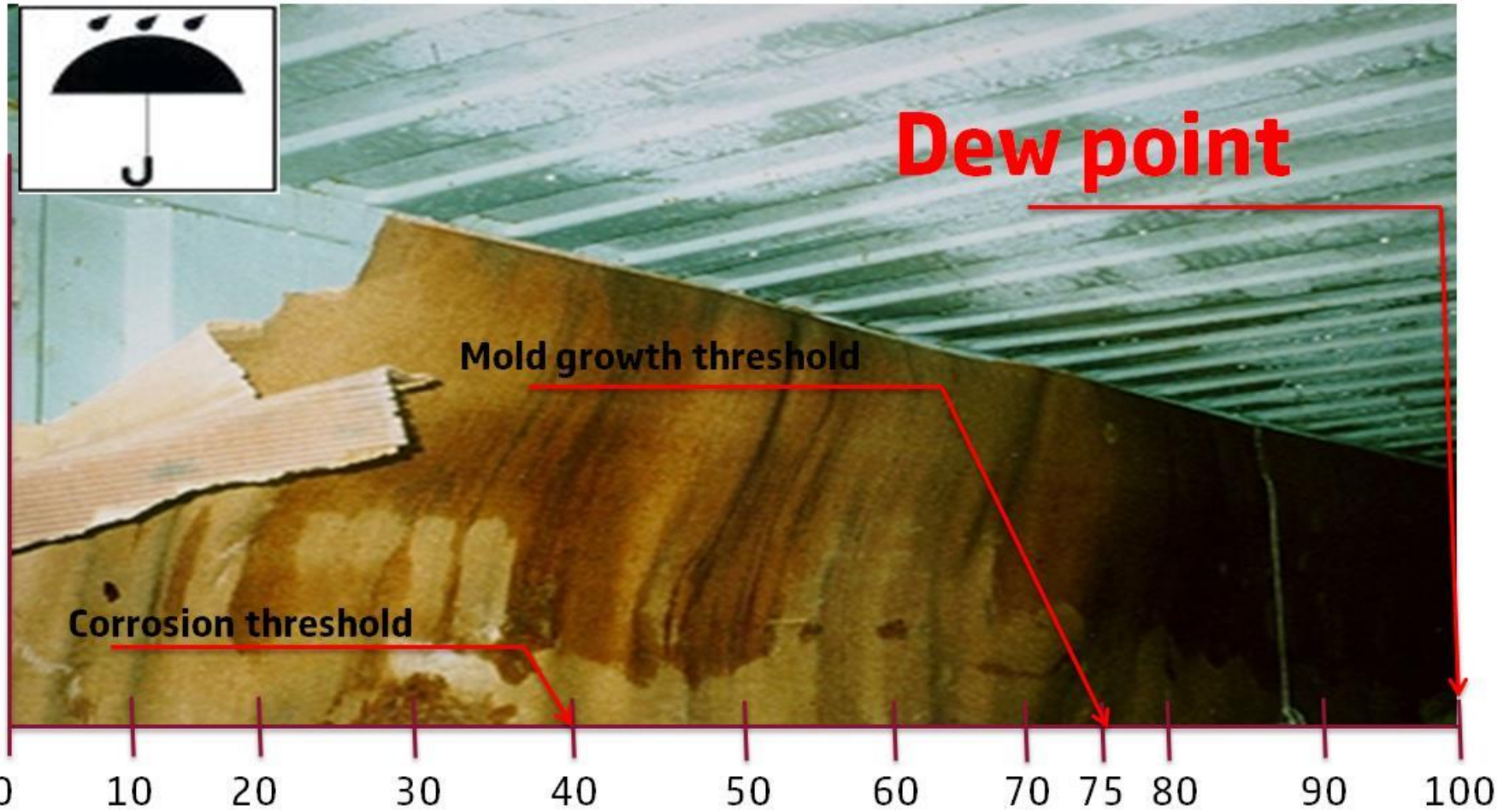
Thresholds



Thresholds

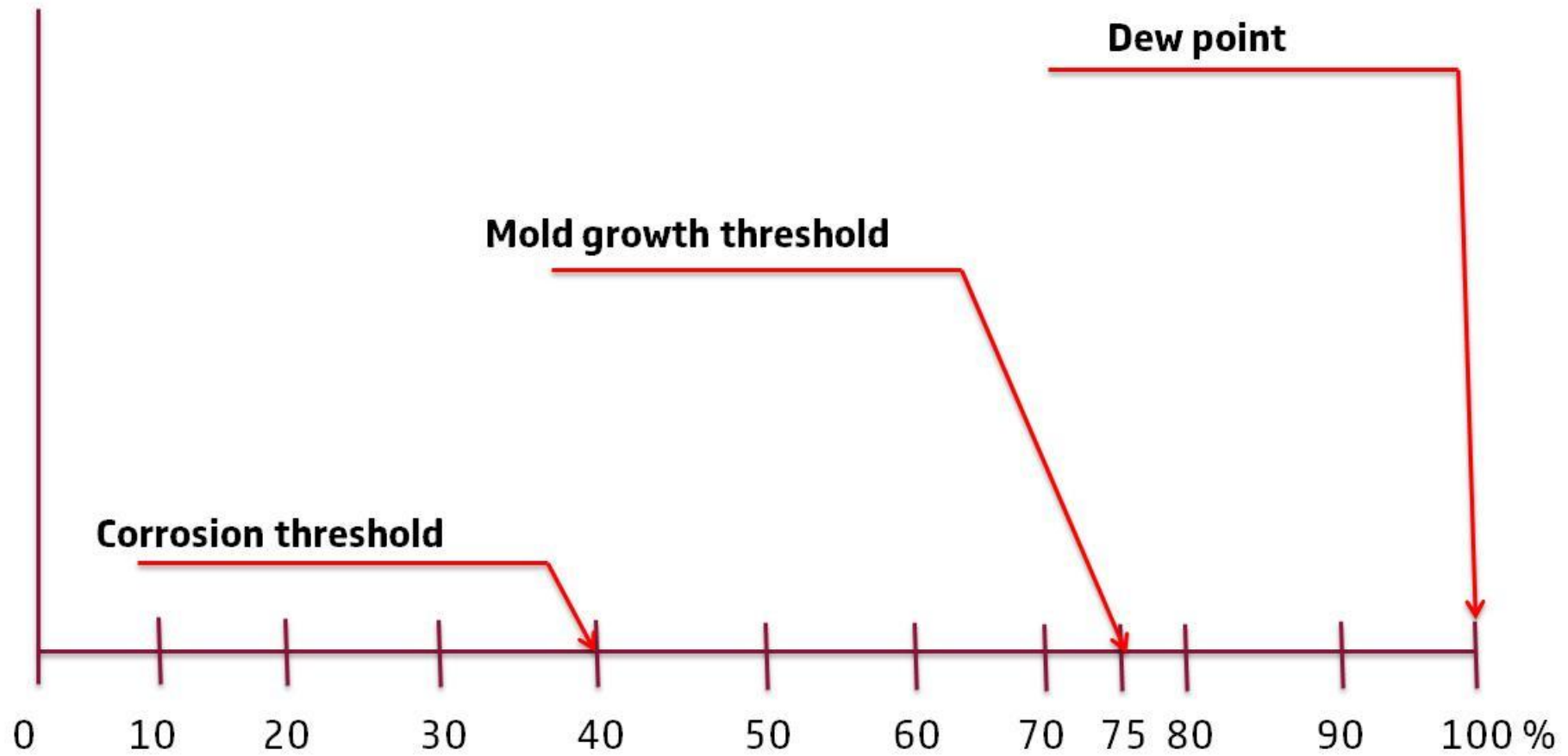


Thresholds



Thresholds

The humidity thresholds



Relative humidity

Temperature

Relative Luftfeuchte	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Lufttemperatur [°C]										
+50	8,3	16,6	24,9	33,2	41,5	49,8	58,1	66,4	74,7	83,0
+45	+8	+19	+26	+32	+36	+40	+43	+45	+48	+50
+40	6,5	13,1	19,6	26,2	32,7	39,3	45,8	52,4	58,9	65,4
+35	+4	+15	+22	+27	+32	+36	+38	+41	+43	+45
+30	5,1	10,2	15,3	20,5	25,6	30,7	35,8	40,9	46,0	51,1
+25	+1	+11	+18	+23	+27	+30	+33	+36	+38	+40
+20	4,0	7,9	11,9	15,8	19,8	23,8	27,7	31,7	35,6	39,6
+15	-2	+8	+14	+18	+21	+25	+28	+31	+33	+35
+10	3,0	6,1	9,1	12,1	15,2	18,2	21,3	24,3	27,3	30,4
+5	-6	+3	+10	+14	+18	+21	+24	+26	+28	+30
0	2,3	4,6	6,9	9,2	11,5	13,8	16,1	18,4	20,7	23,0
-5	-8	0	+5	+10	+13	+16	+19	+21	+23	+25

Dew point

Relative humidity

Temperature

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	+8	+19	+26	+32	+36	+40	+43	+45	+48	+50
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	+4	+15	+22	+27	+32	+36	+38	+41	+43	+45
+40	5,1	10,2	15,3	20,5	25,6	30,7	35,8	40,9	46,0	51,1
	+1	+11	+18	+23	+27	+30	+33	+36	+38	+40
+35	4,0	7,9	11,9	15,8	19,8	23,8	27,7	31,7	35,6	39,6
	-2	+8	+14	+18	+21	+25	+28	+31	+33	+35
+30	3,0	6,1	9,1	12,1	15,2	18,2	21,3	24,3	27,3	30,4
	-6	+3	+10	+14	+18	+21	+24	+26	+28	+30
+25	2,3	4,6	6,9	9,2	11,5	13,8	16,1	18,4	20,7	23,0
	-8	0	+5	+10	+13	+16	+19	+21	+23	+25

Dew point

Relative humidity

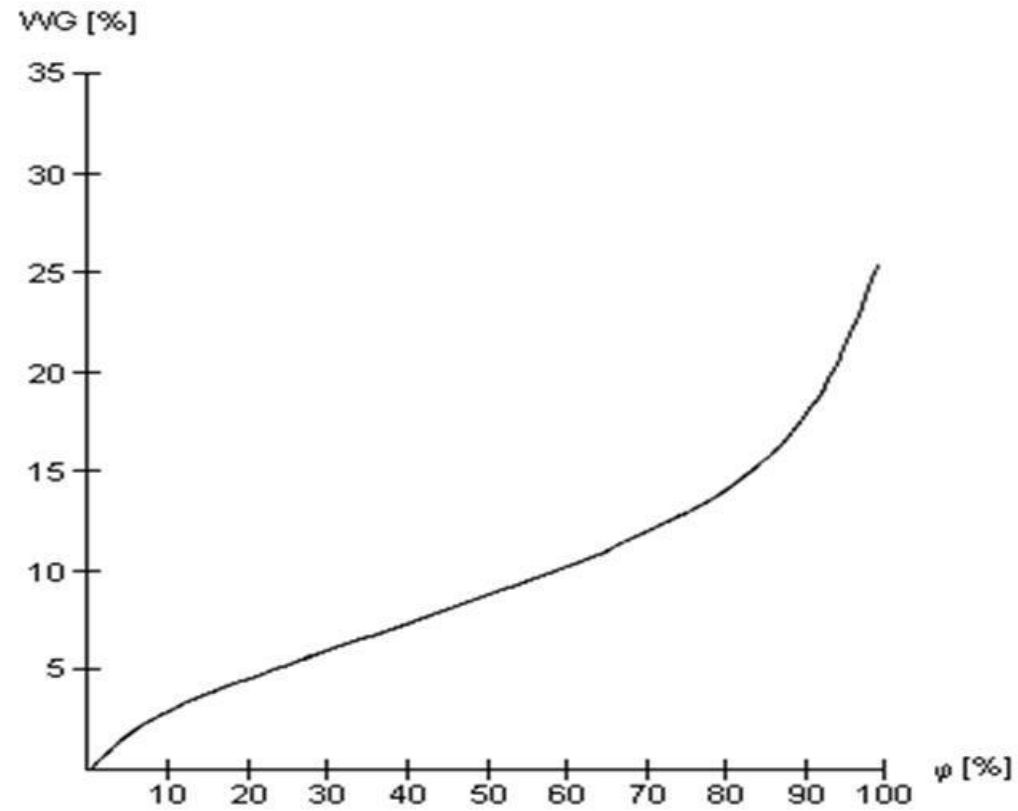
Temperature

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+25	2,3	4,6	6,9	9,2	11,5	13,8	16,1	18,4	20,7	23,0
	-8	0	+5	+10	+13	+16	+19	+21	+23	+25

Dew point

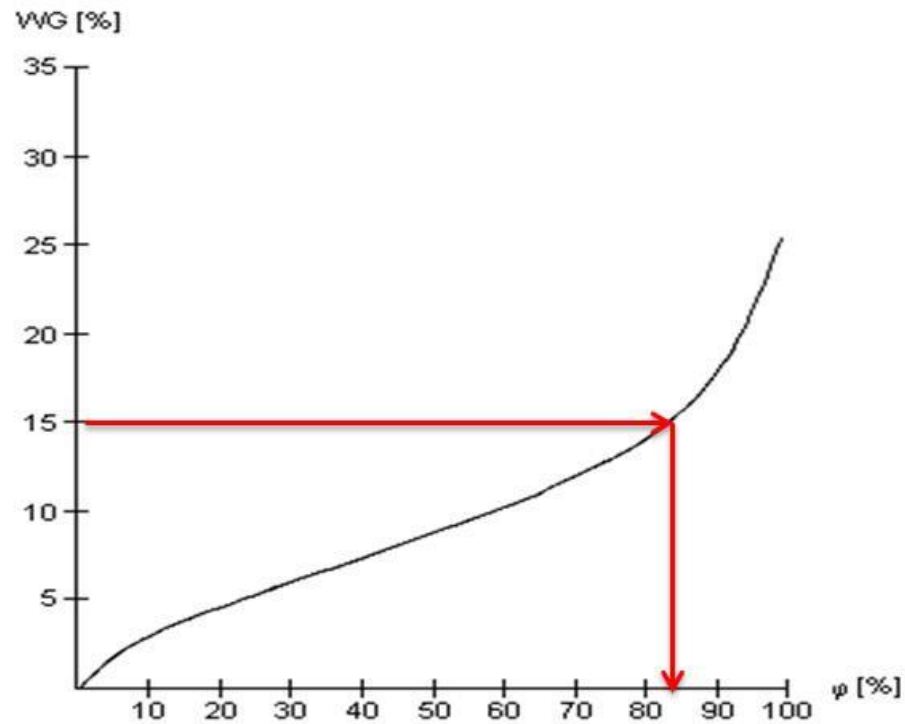
Sorption behavior

Sorption behavior



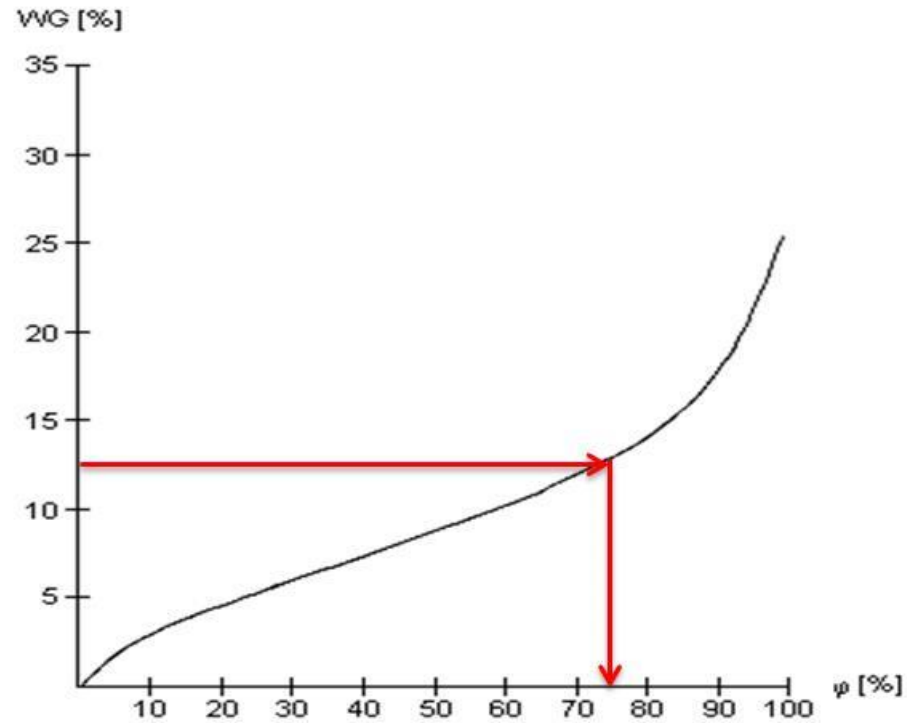
Sorption behavior

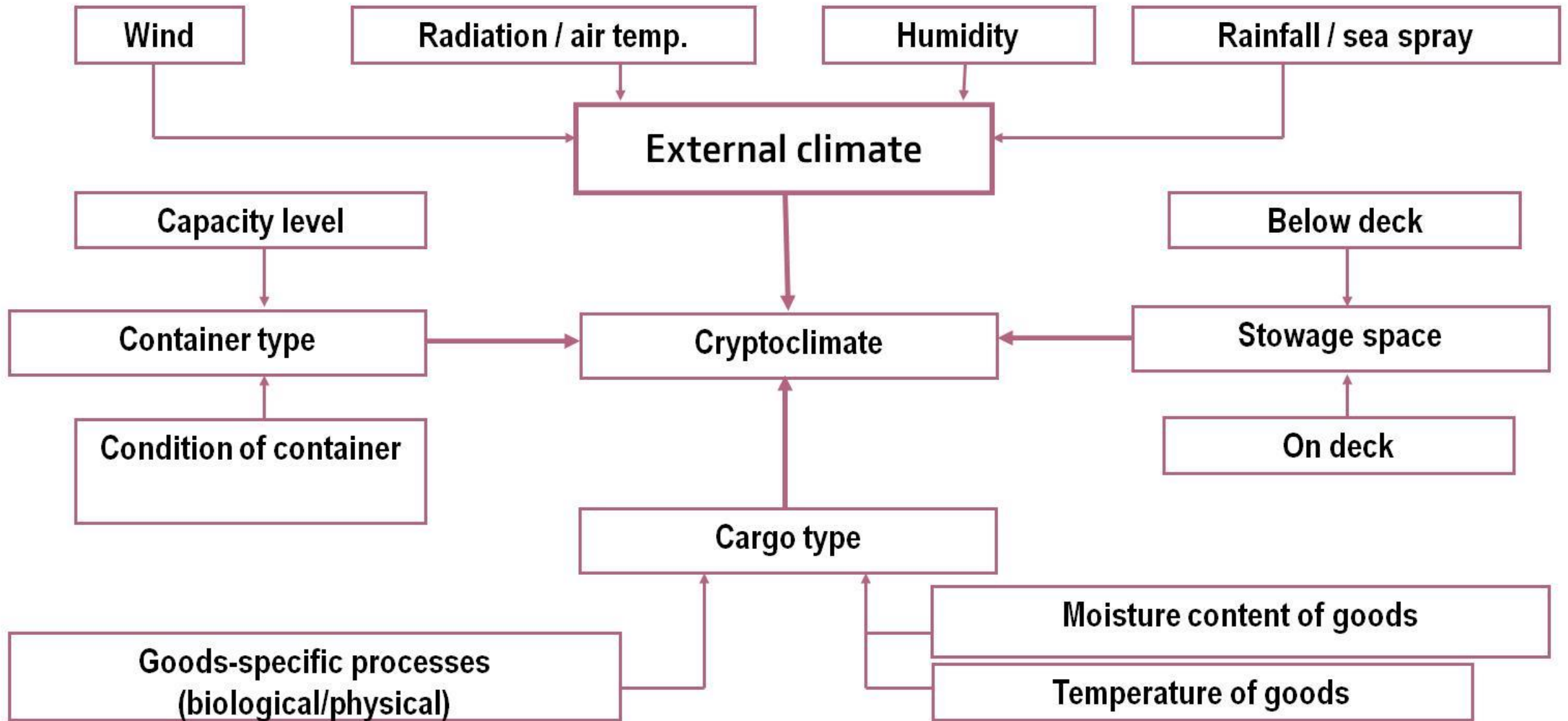
Pine sorption isotherm



Sorption behavior

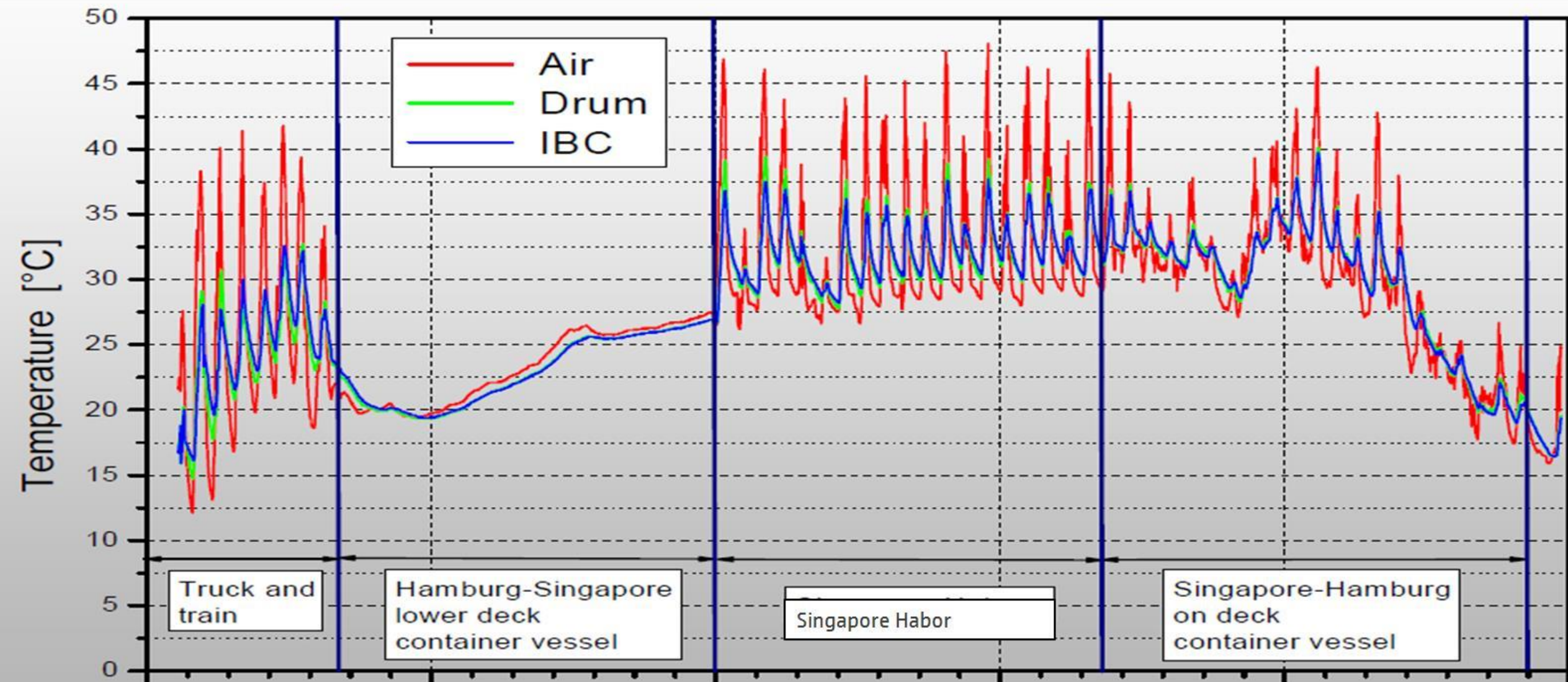
Pine sorption isotherm



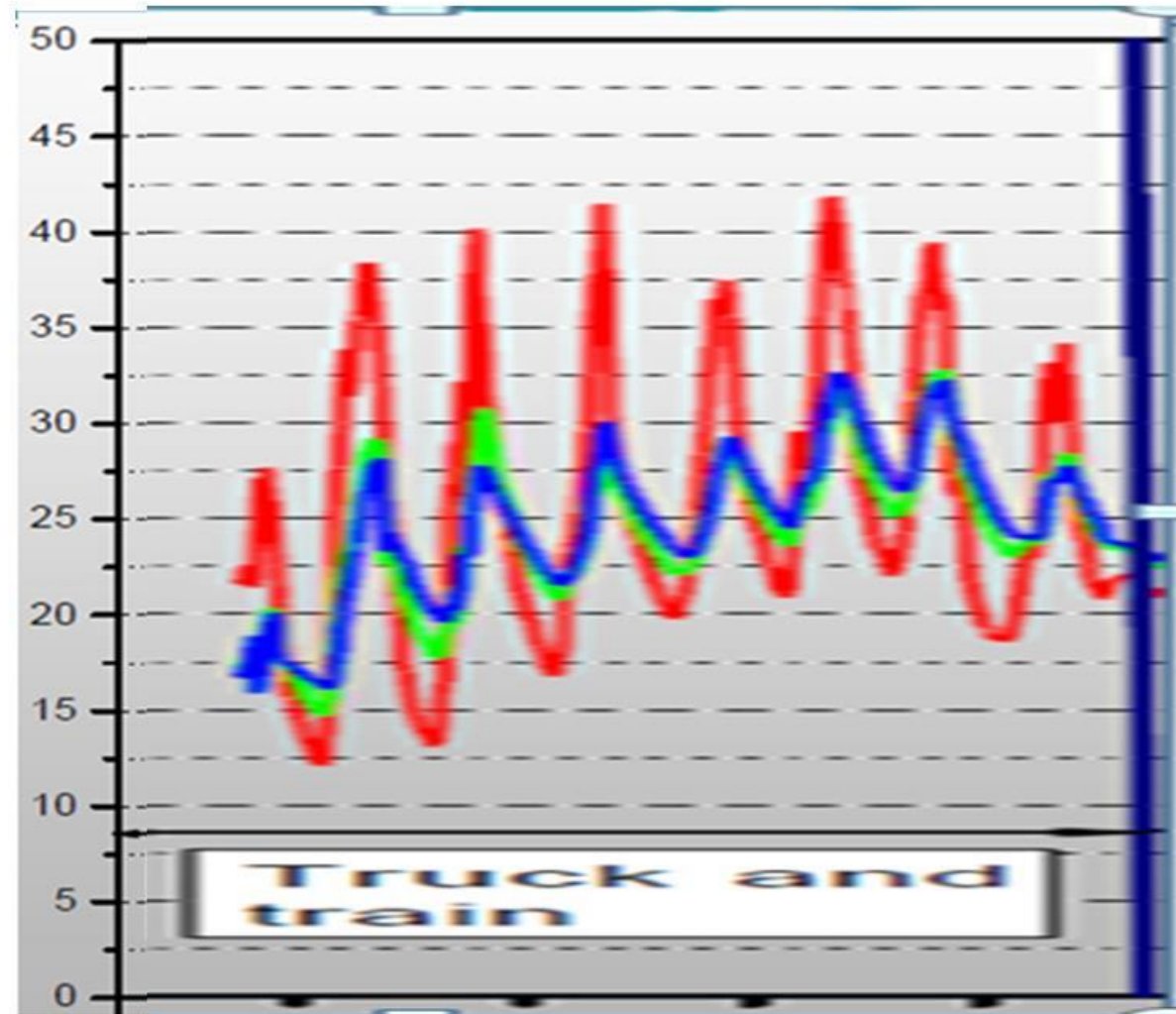


Test voyages

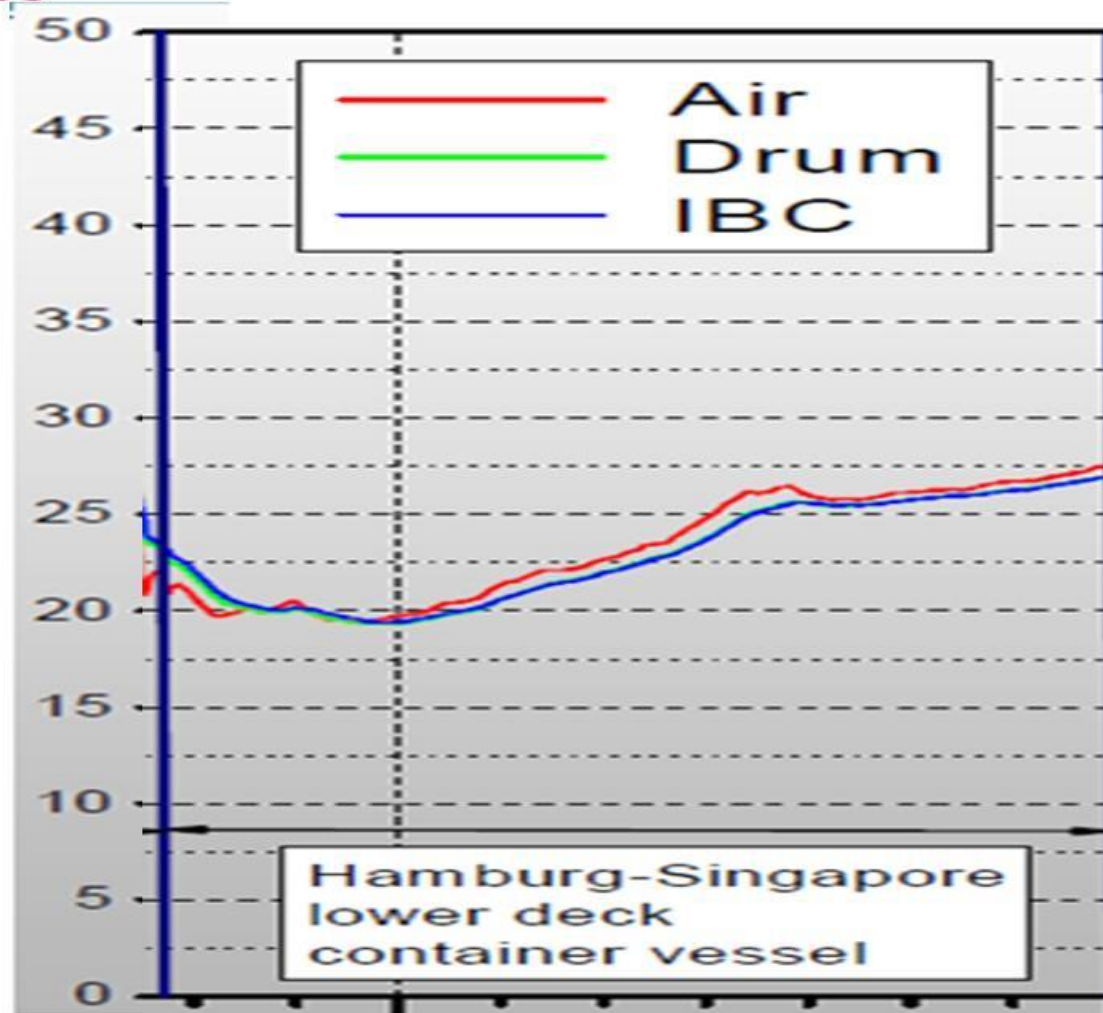
Test voyages



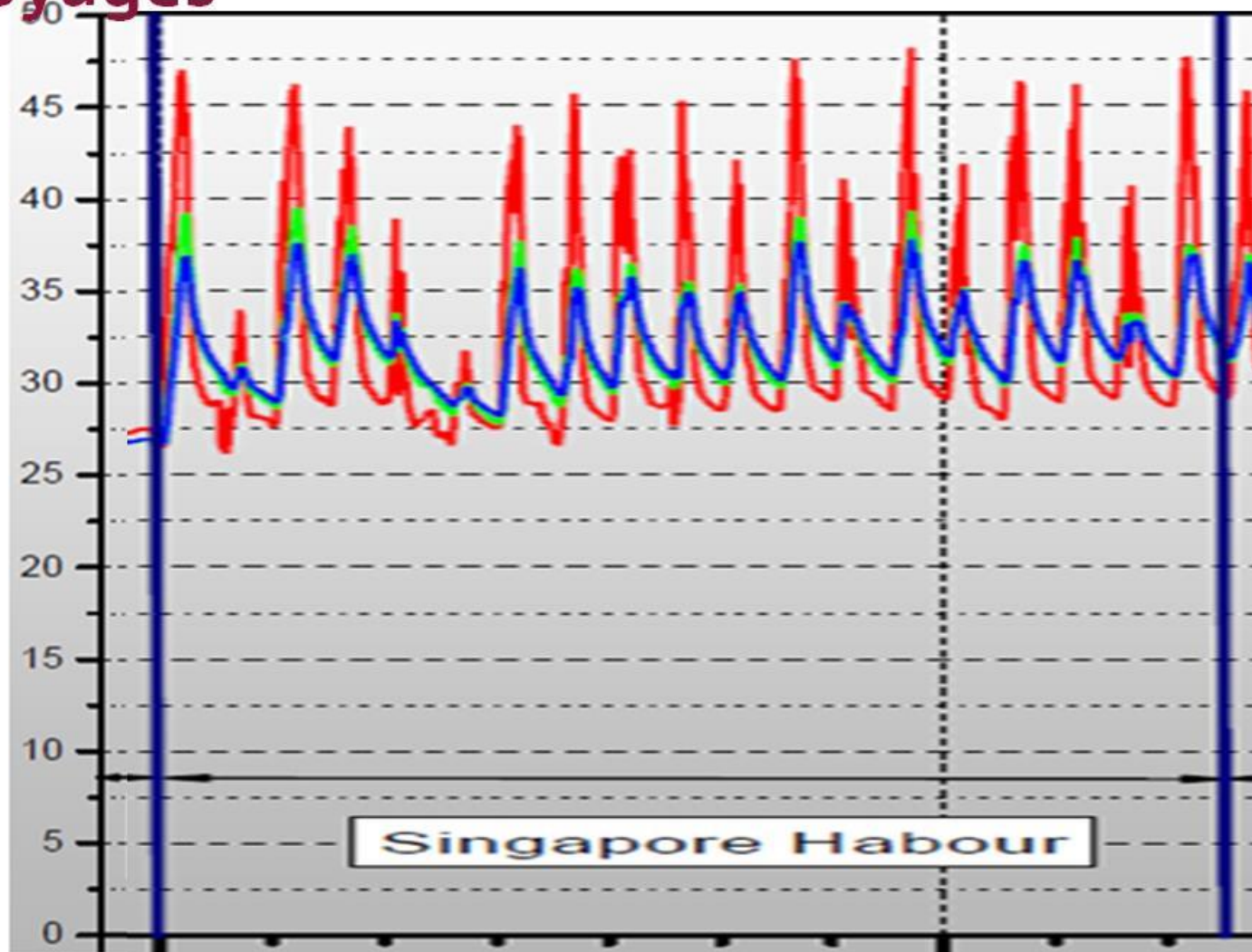
Test voyages



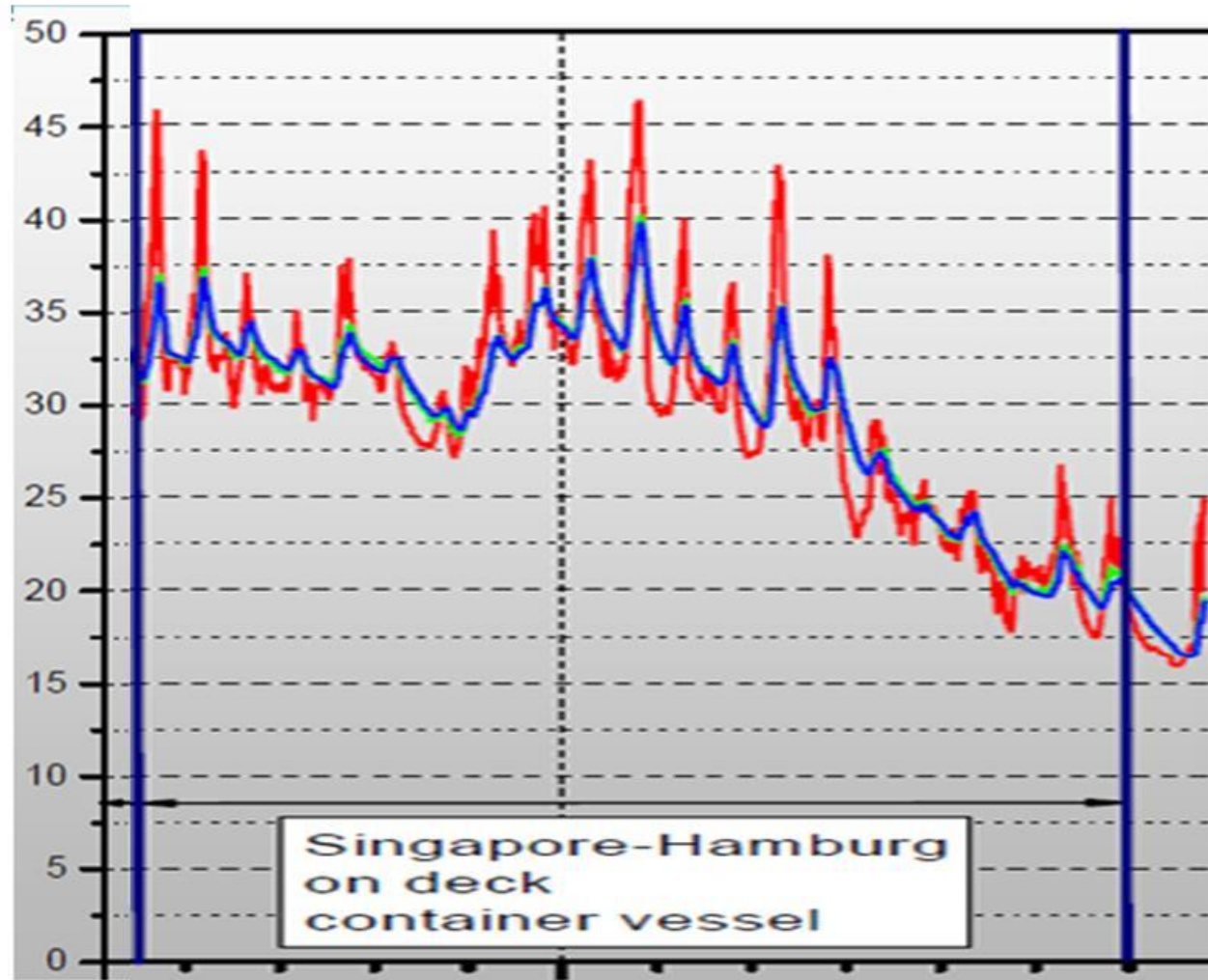
Test voyages



Test voyages

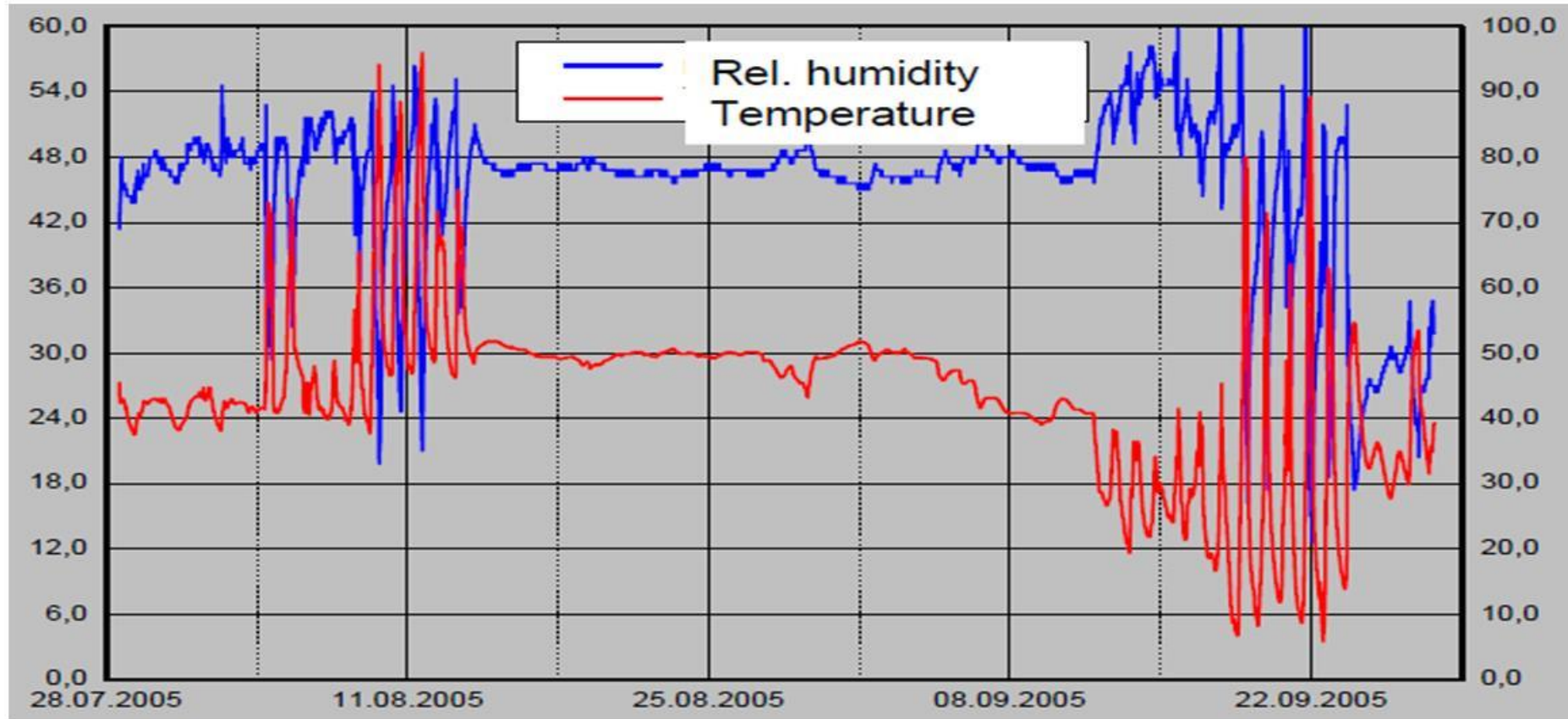


Test voyages

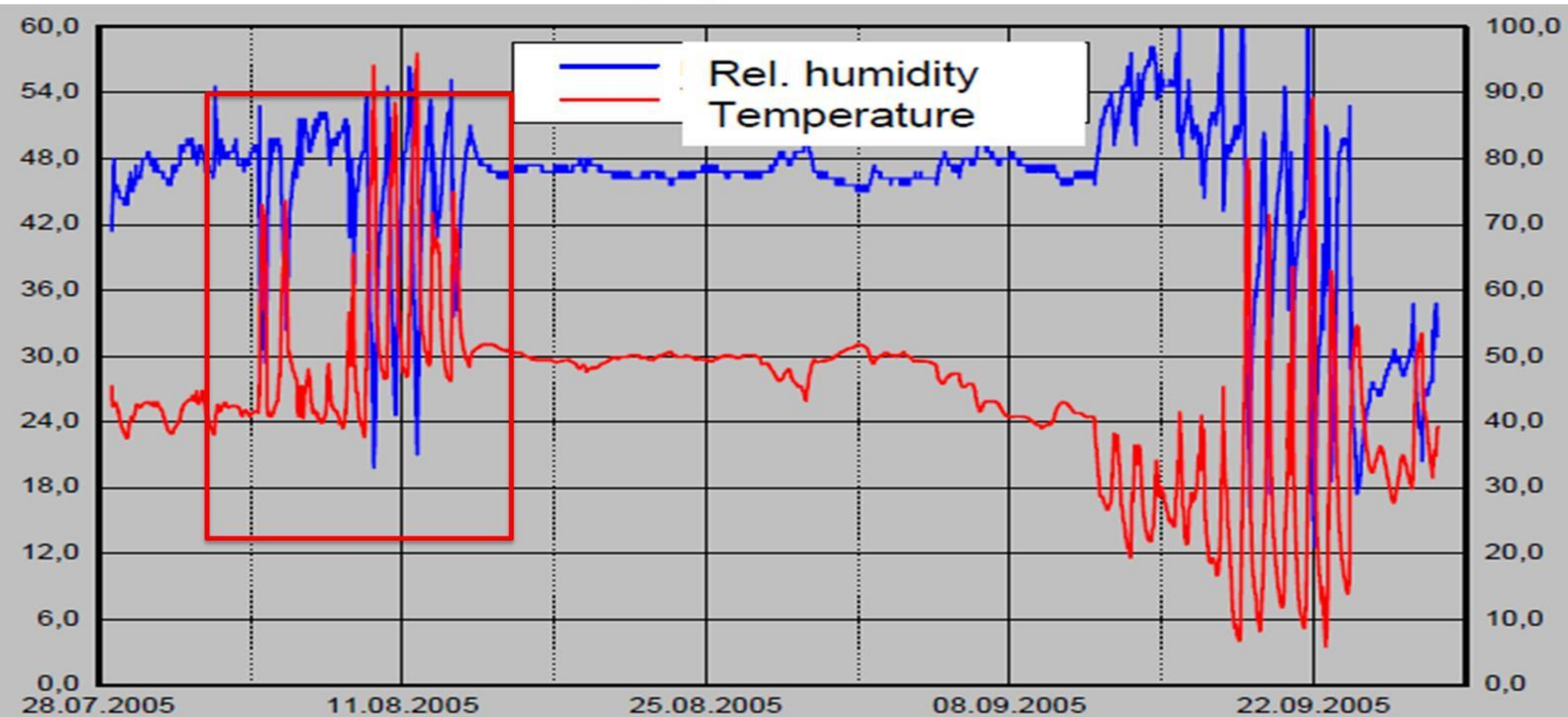


Test voyages

Transport from China to Germany



Test voyages

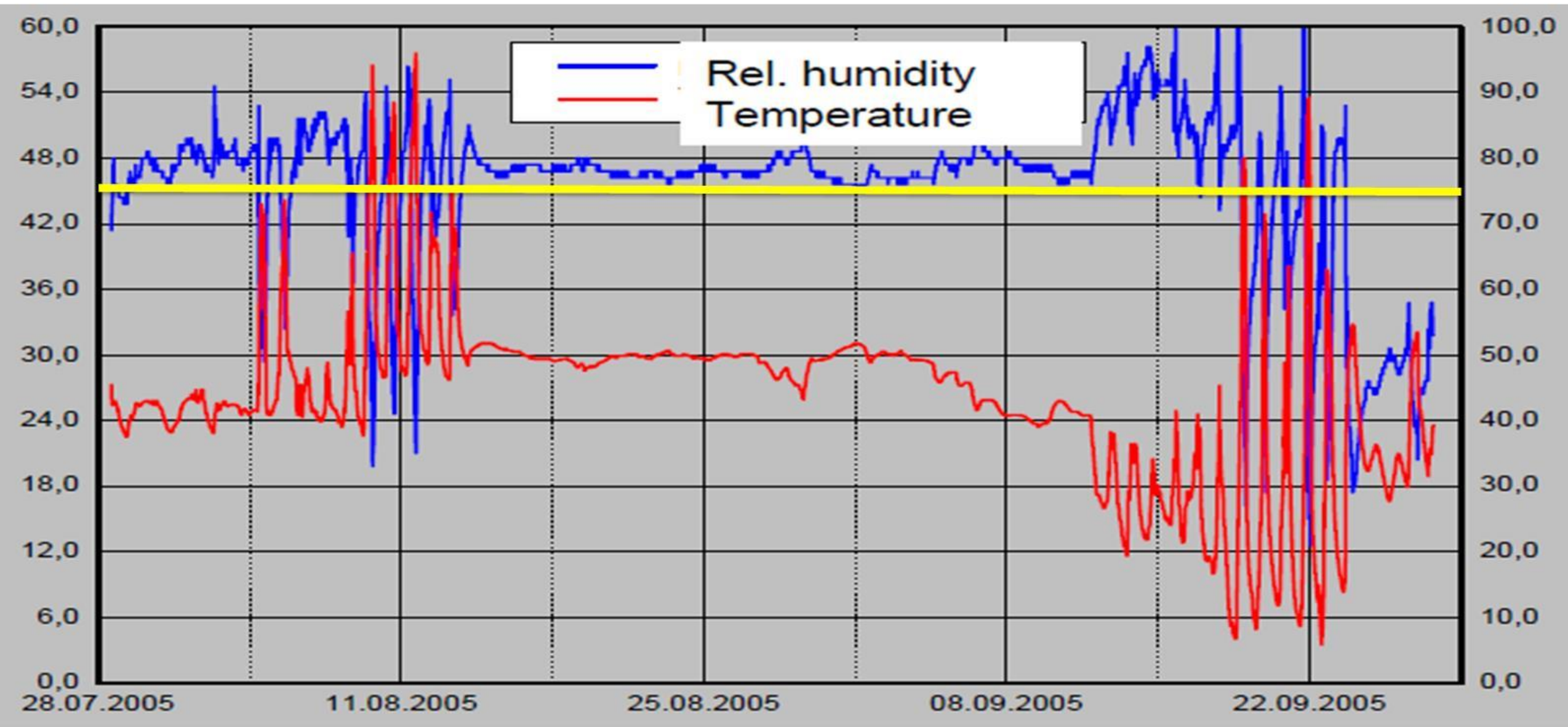


Test voyages

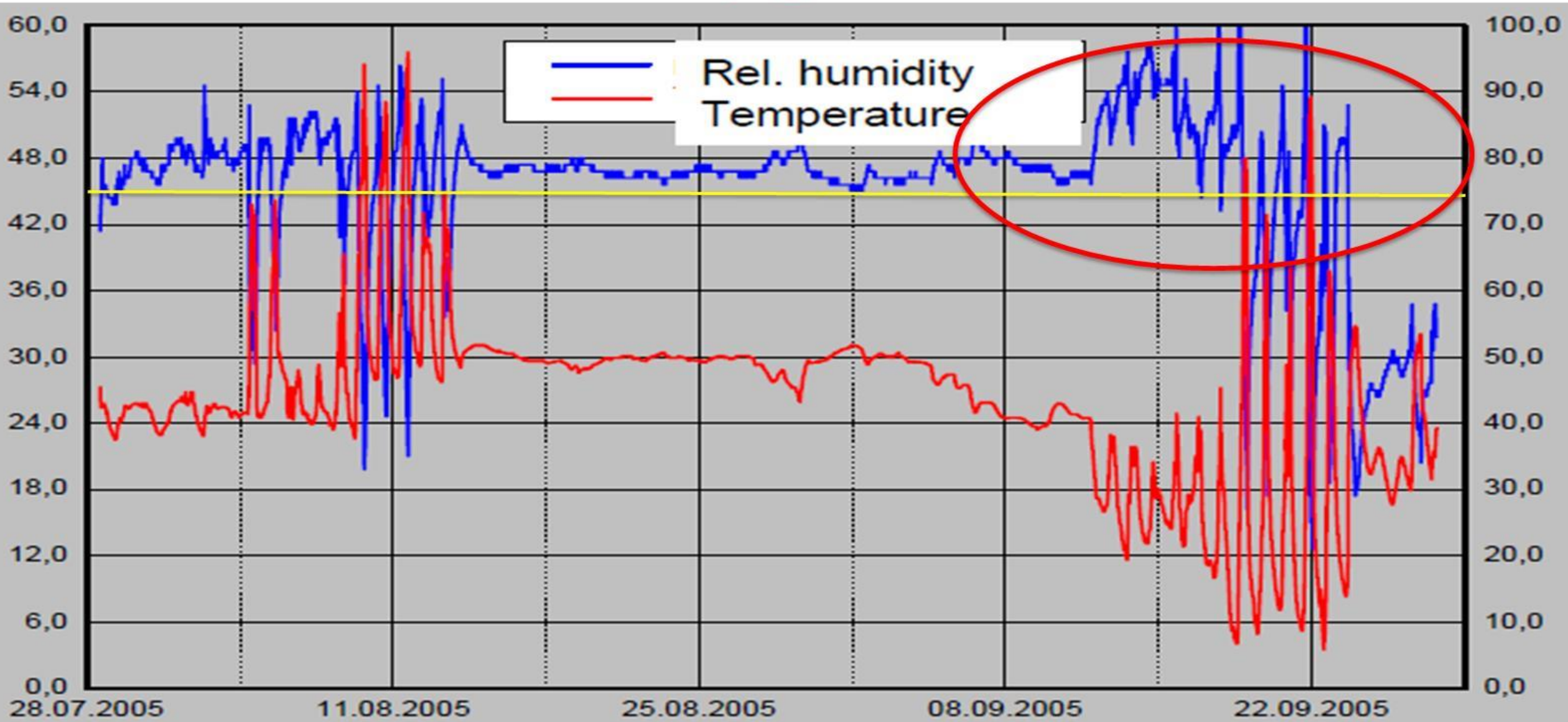
Temperature

Rel.
Humidity

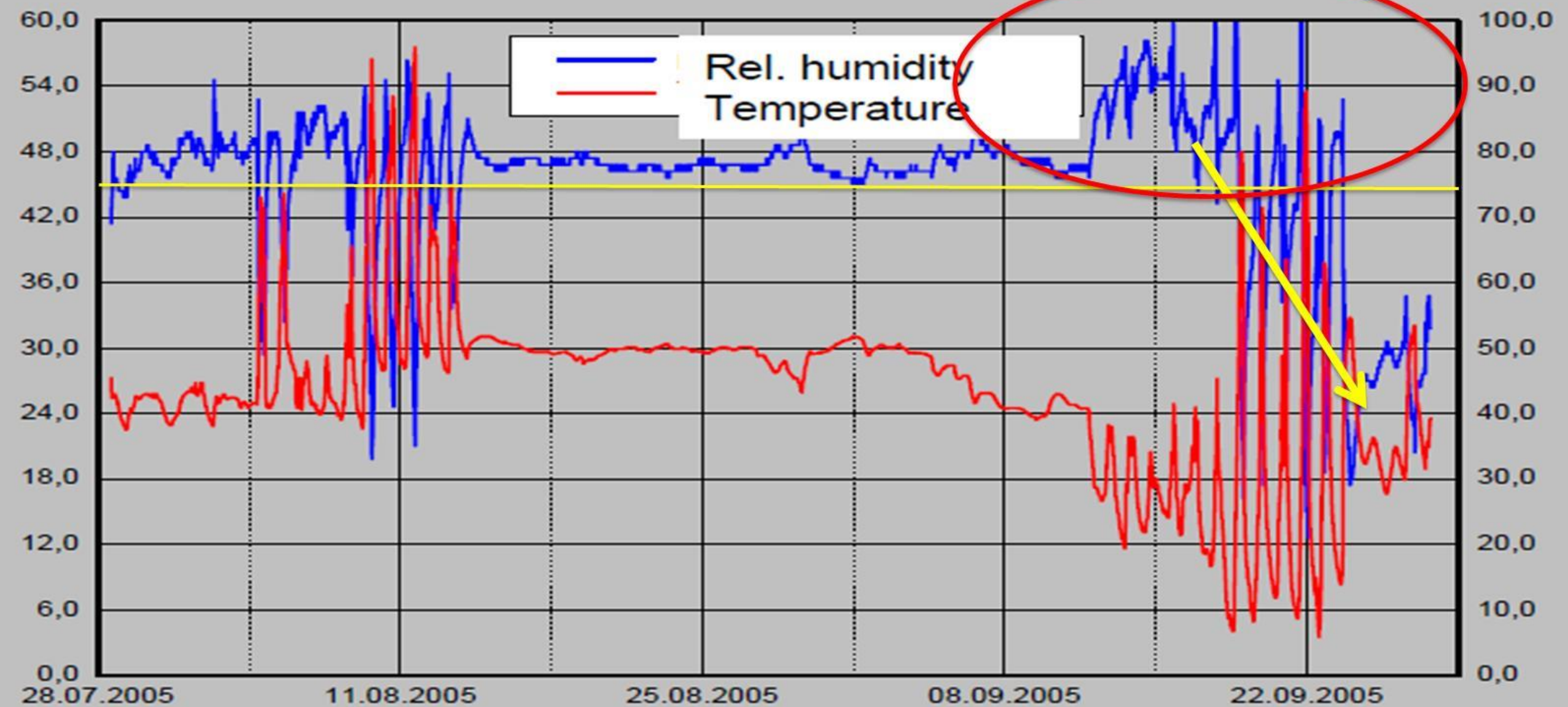
Test voyages



Test voyages



Test voyages

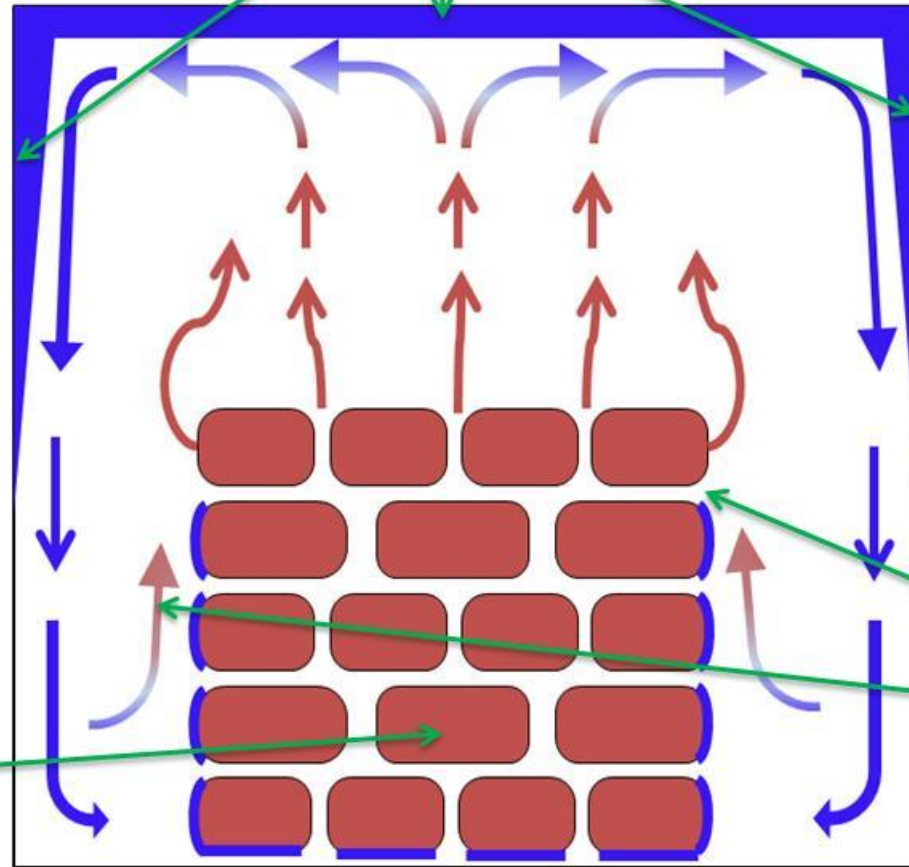


Condensation

Condensation

Condensation area

Warm
steamy cargo



Warm-up area

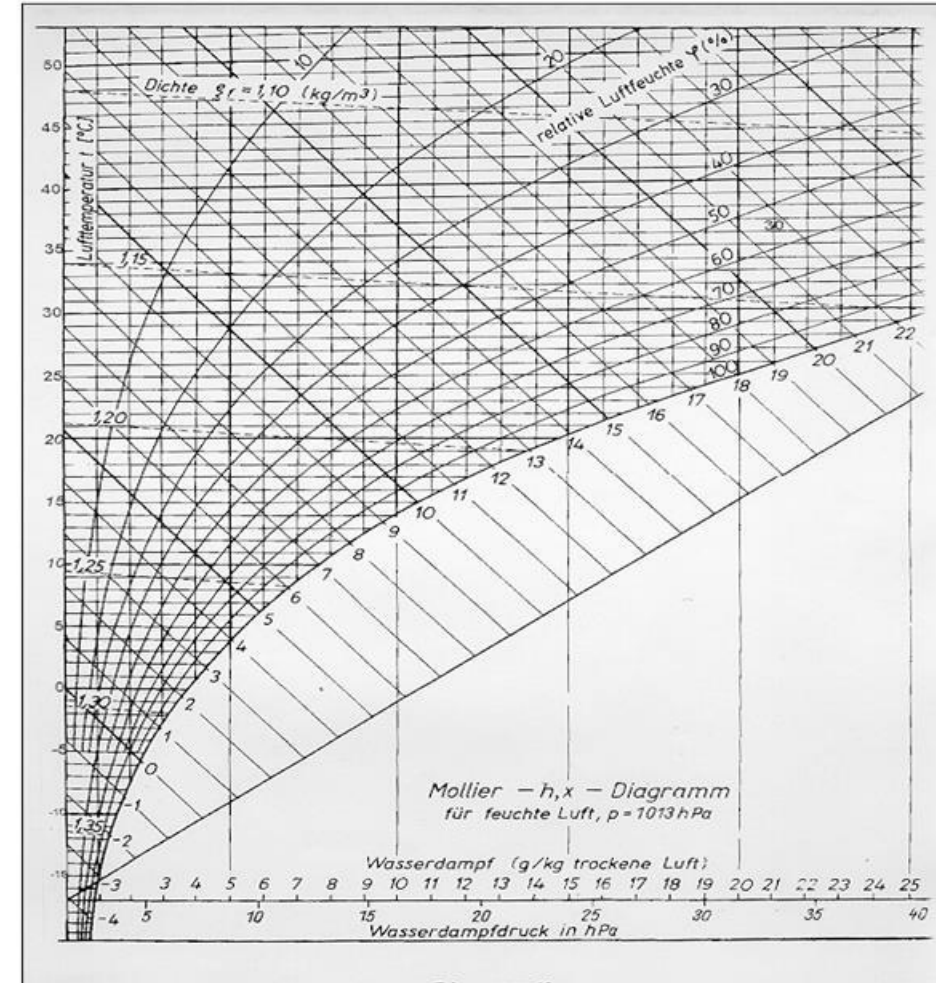
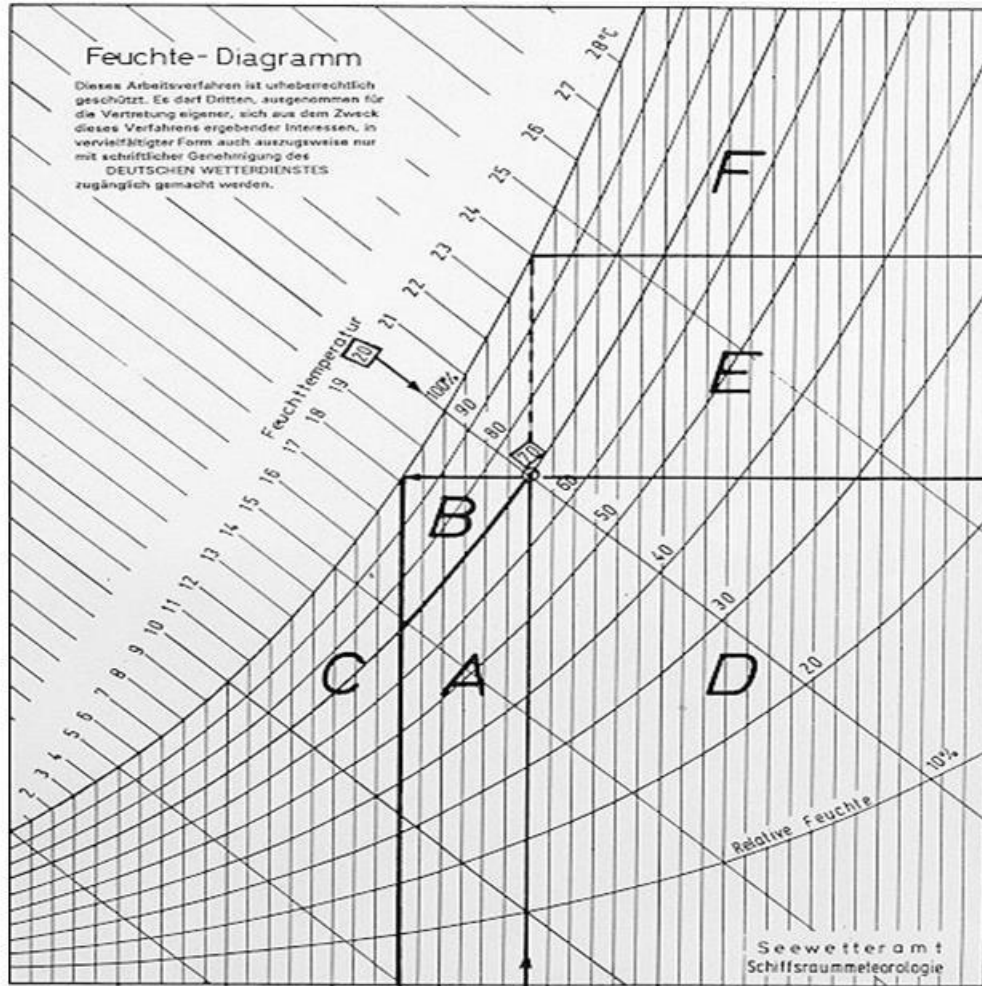
80 liters of water from 20 tonnes of cocoa



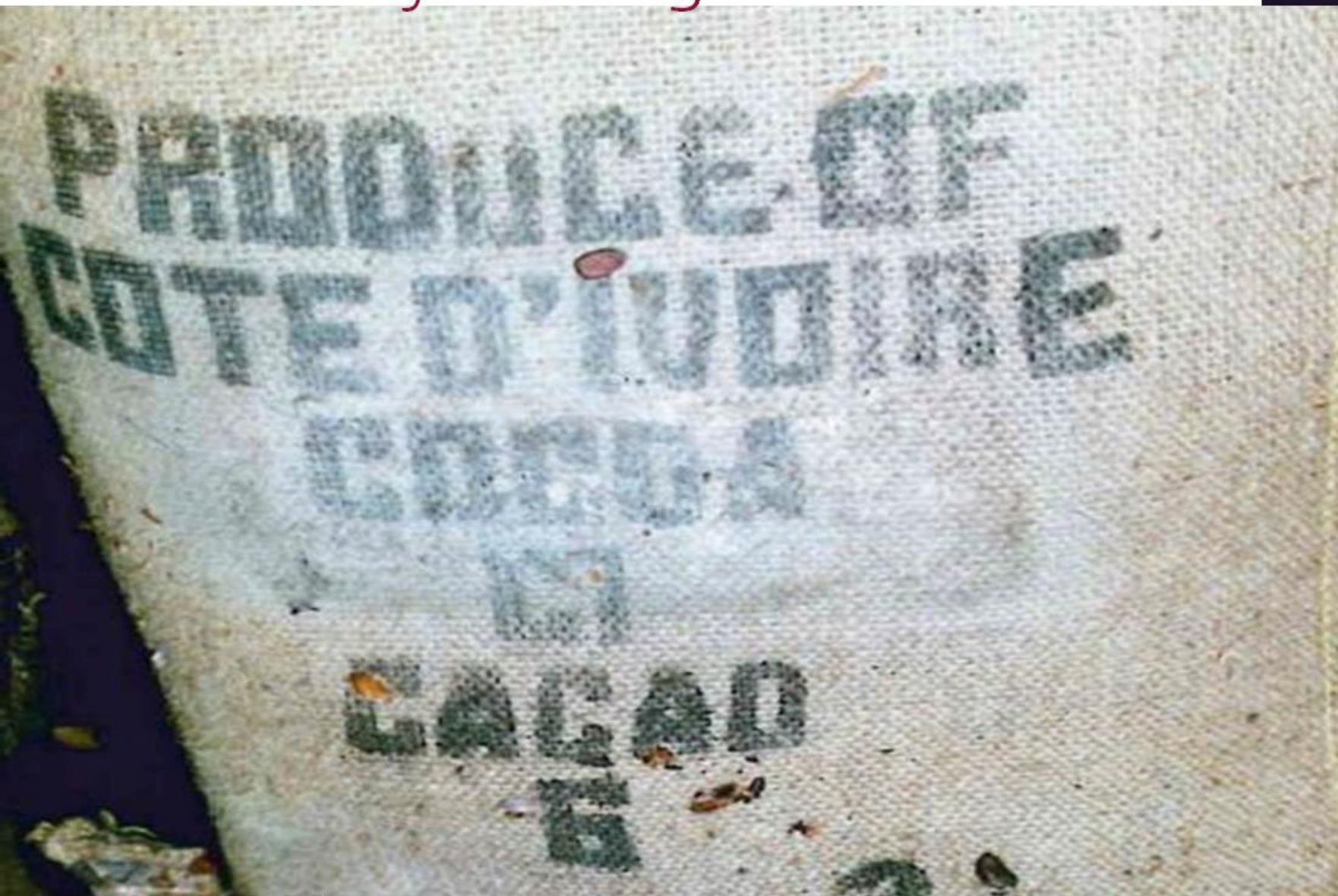
Use of dessicants



Ventilation on a vessel

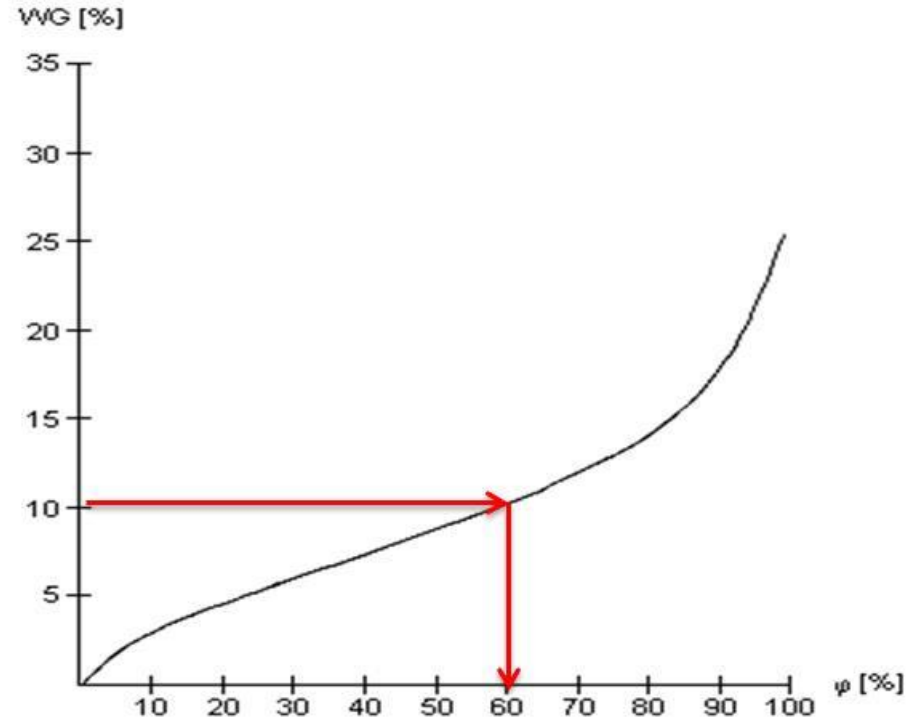


Humidity Management



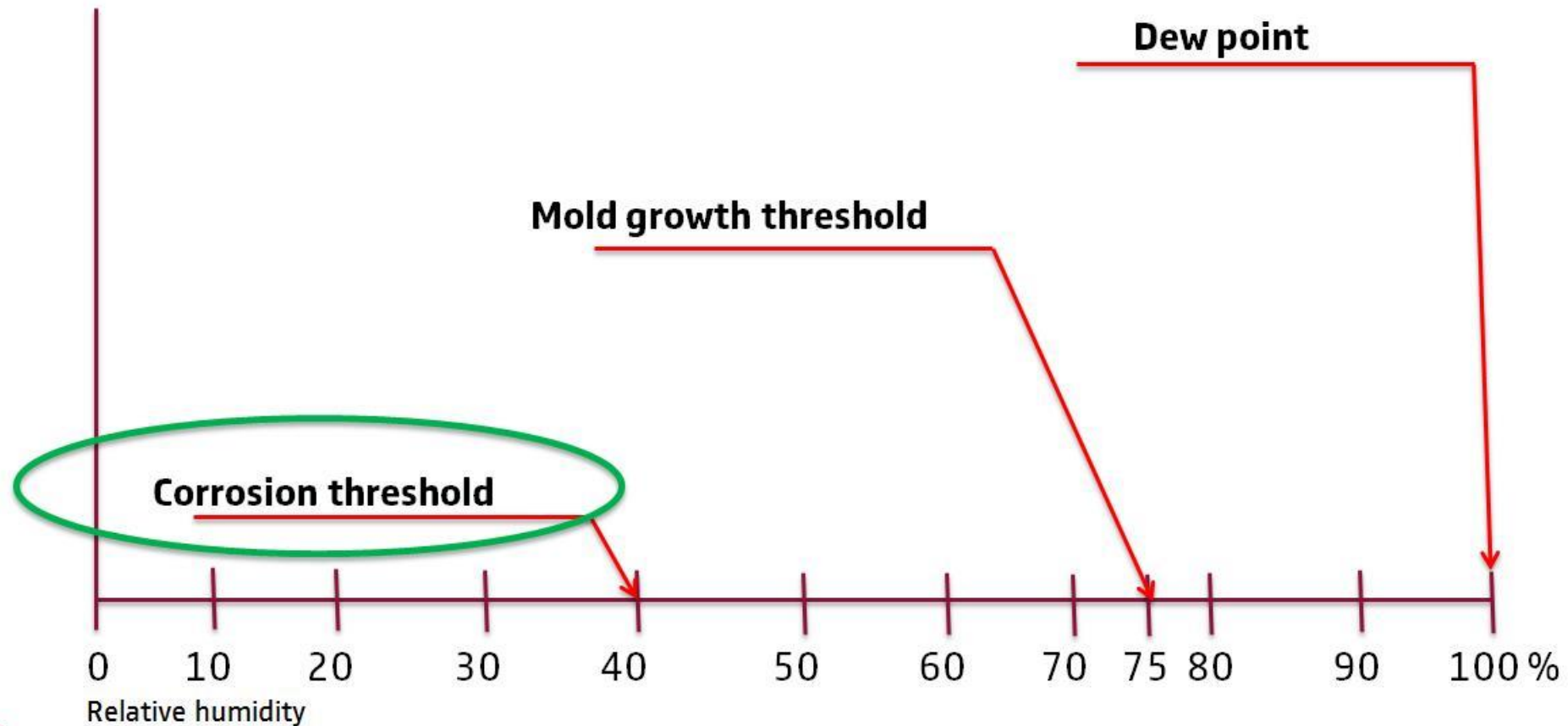
Humidity Management

Container-dry



Humidity Management

The humidity thresholds



Humidity Management

Corrosion threshold



Humidity Management

Corrosion threshold



Humidity Management



IMO/ILO/UNECE

Code of Practice for Packing Cargo in Transport Units
(CTU Code 2014/2015)

Annex 3 Prevention of Condensation Damage

Conclusion

Conclusion

- **The objective is "container-dry,,**
- **And this term is now included in the CTU Code**
- **The use of dessicants outside of sealed packaging makes little sense**
- **The use of dessicants for corrosion protection requires specialist skill and must be done properly**
- **Active ventilation helps to prevent condensation, but has its limitations**

Conclusion

- **Damage from excess moisture can be avoided**
- **The water content of the cargo is the key to success**
- **If no moisture has come from the outside, then the internal moisture has caused the damage**
- **The correct water content is a quality characteristic of the cargo**
- **Mold and so on do not generally represent transport damage rather they are a problem with the cargo itself**

Humidity management



Using the CTU Code, insurers can help their clients to achieve loss-free transport. This is the goal of all **loss prevention work.**

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Registration now open**

Twitter

1h

ELP „Moisture when transporting goods“

MOISTURE WHEN TRANSPORTING GOODS,
AS EXEMPLIFIED BY CONTAINERS

0:00 / 2:12

Unassisted learning Guided learning Glossary


play video 01 ELP

ELP „Moisture when transporting goods“

Example of a Humidity table

UNASSISTED LEARNING

- The container
- Risk factor air
- Causes of transport loss
- Humidity table
- Humidity/moisture measurement
- Protective measures during transport



ELP „Moisture when transporting goods“

Example of a Humidity table

UNASSISTED LEARNING

- The container
- Risk factor air
- Causes of transport loss
- Humidity table**
- Humidity/moisture measurement
- Protective measures during transport

A blue water drop character with eyes and a smile is located at the bottom right of the interface.

ELP „Moisture when transporting goods“

Example of a Humidity table

UNASSISTED LEARNING

The container

Risk factor air

Humidity/moisture measurement

Navigation icons: home, search, list, book, back, forward

Features of the humidity table

DEFINITION STRUCTURE USE

The humidity table can be used to determine what the relative humidity will be in an enclosed space at a given temperature and how it reacts as the temperature changes.

Relative Humidity	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Air temperature (°C)										
+30	8.9	16.8	24.9	33.2	41.8	50.8	59.1	66.8	74.7	83.0
+25	6.8	13.1	19.6	26.2	32.7	39.3	45.9	52.4	59.0	65.4
+20	5.1	10.2	15.3	20.4	25.5	30.7	35.8	40.9	46.0	51.1
+15	4.0	7.9	11.9	15.8	19.8	23.8	27.7	31.7	35.6	39.6
+10	3.0	6.1	9.1	12.1	15.2	18.2	21.3	24.3	27.3	30.4
+5	2.3	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7	23.0
0	1.7	3.4	5.2	6.9	8.7	10.4	12.1	13.8	15.5	17.2
-5	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0
-10	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0
-15	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0
-20	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0





Dew point




Structure of the humidity table



ELP „Moisture when transporting goods“

Example of a Humidity table

Features of the humidity table i


DEFINITION
STRUCTURE
USE

The humidity table can be used to determine what the relative humidity will be in an enclosed space at a given temperature and how it reacts as the temperature changes.

Relative humidity (%)

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+45	6,0	9,1	12,2	15,3	18,4	21,5	24,6	27,7	30,8	33,9
+40	5,1	7,7	10,3	12,9	15,5	18,1	20,7	23,3	25,9	28,5
+35	4,2	6,4	8,6	10,8	13,0	15,2	17,4	19,6	21,8	24,0
+30	3,3	5,1	6,9	8,7	10,5	12,3	14,1	15,9	17,7	19,5
+25	2,4	3,8	5,2	6,6	8,0	9,4	10,8	12,2	13,6	15,0
+20	1,5	2,4	3,3	4,2	5,1	6,0	6,9	7,8	8,7	9,6
+15	0,6	1,0	1,4	1,8	2,2	2,6	3,0	3,4	3,8	4,2
+10	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0
+5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Structure of the humidity table



ELP „Moisture when transporting goods“

Navigation icons: Home, Search, List, Bookmarks, Mobile view, Previous, Next.

Features of the humidity table ⁱ

DEFINITION STRUCTURE USE


The structure of the humidity table and the humidity chart is described briefly in these videos:

A video thumbnail showing a table with two main columns: 'Air temperature (°C)' and 'Relative humidity (%)'. The table contains numerical data for various temperature and humidity levels. A play button is centered over the table.

Structure of the humidity table

A video thumbnail showing a graph with 'Absolute humidity (g/m³)' on the vertical axis and 'Relative humidity (%)' on the horizontal axis. Several red curves represent the relationship between absolute and relative humidity at different temperatures. A play button is centered over the graph.

Structure of a humidity chart



ELP „Moisture when transporting goods“

Navigation icons: Home, Search, List, Bookmarks, Grid, Previous, Next

Features of the humidity table ⁱ

DEFINITION STRUCTURE USE


The structure of the humidity table and the humidity chart is described briefly in these videos:

A video thumbnail showing a table with two columns: 'Air temperature (°C)' and 'Relative humidity (%)'. The table contains numerical data for various temperatures. A play button is centered over the table. Below the table is a video player control bar showing '0:00 / 1:02'.

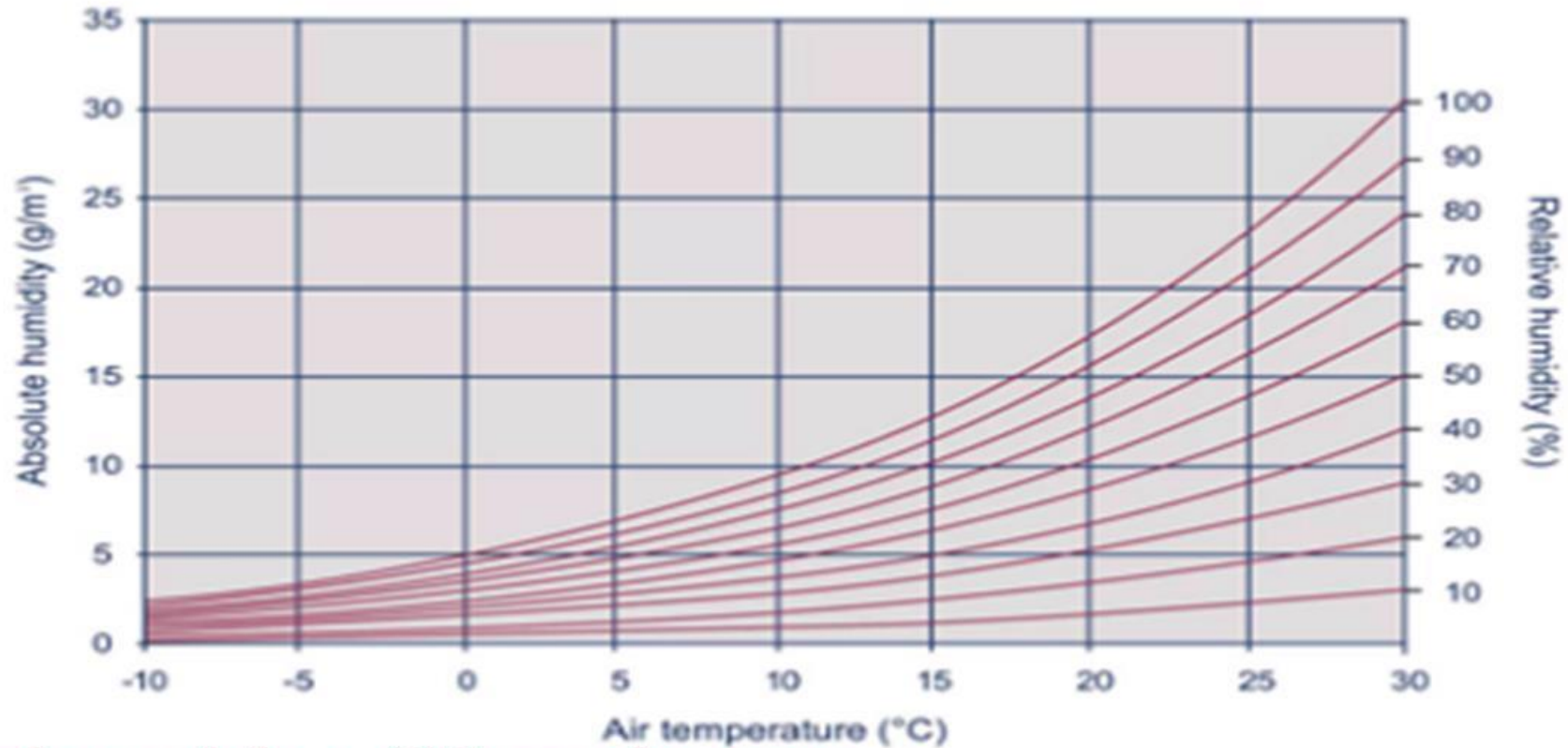
Structure of the humidity table

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Structure of a humidity chart



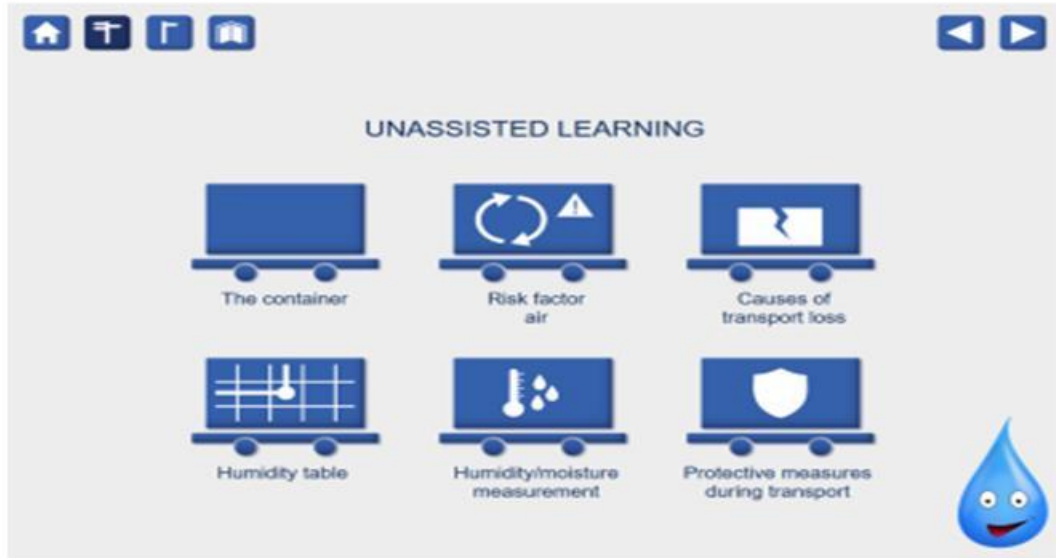
ELP „Moisture when transporting goods“



play video 02 moisture

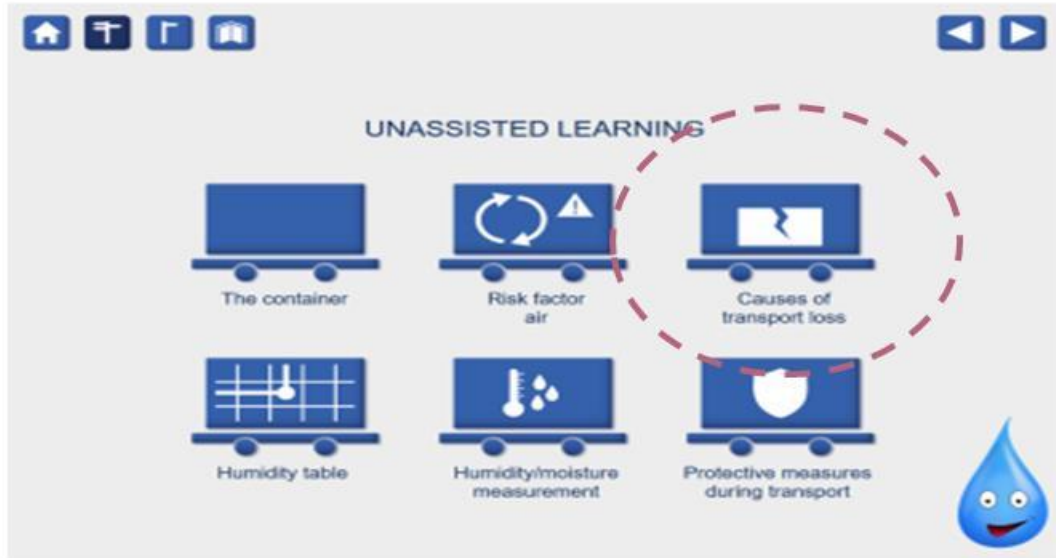
ELP „Moisture when transporting goods“

Examples for the buildingblock „Cases of transport losses“



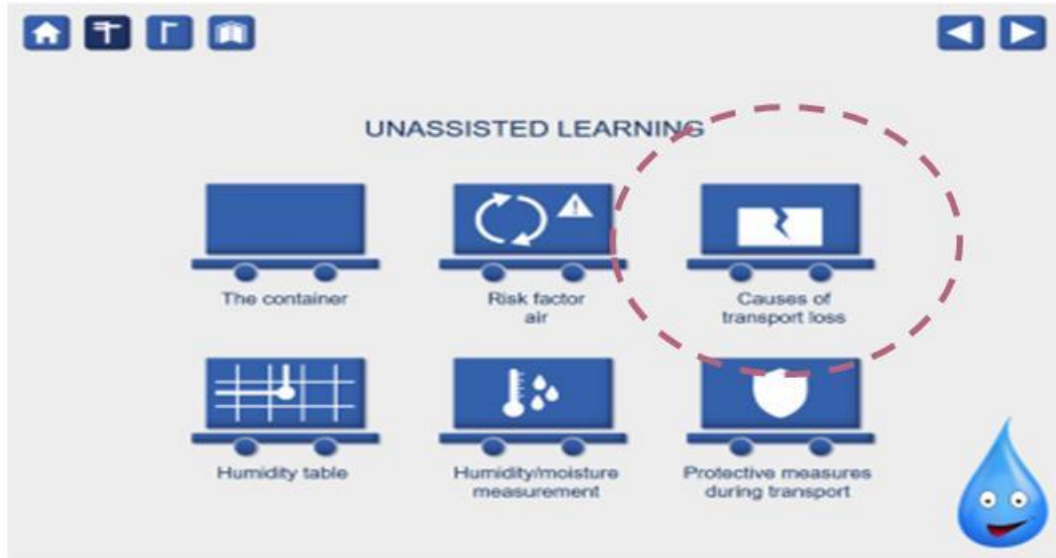
ELP „Moisture when transporting goods“

Examples for the buildingblock „Cases of transport losses“



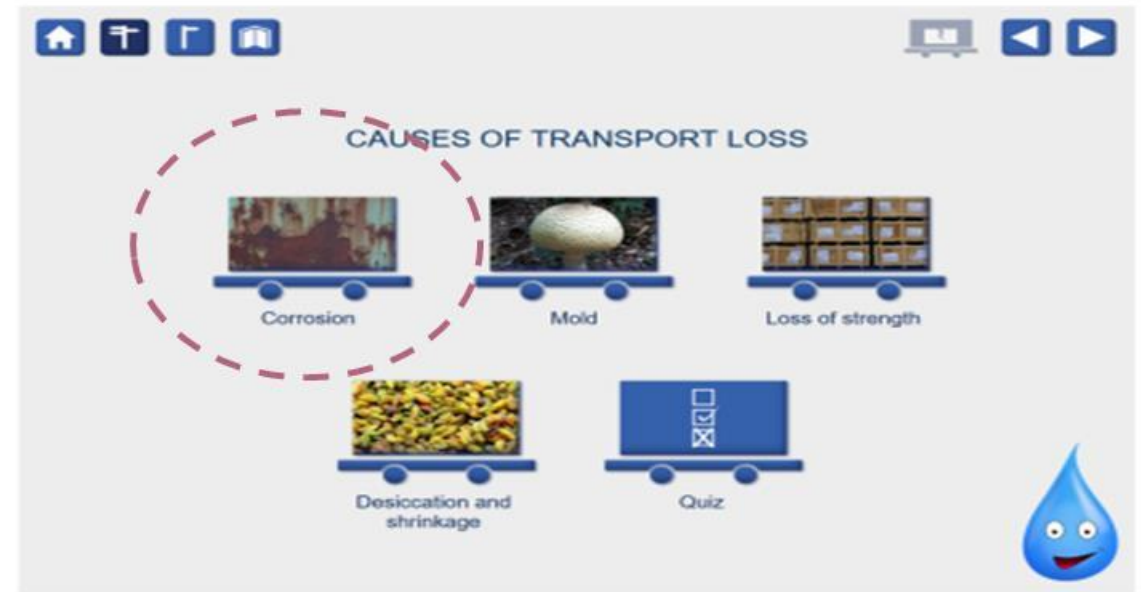
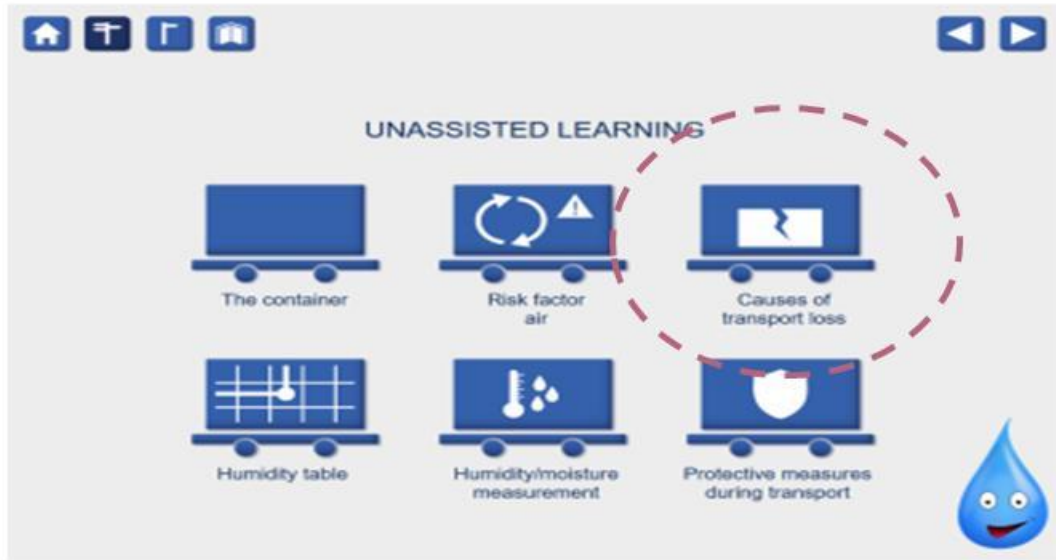
ELP „Moisture when transporting goods“

Examples for the buildingblock „Cases of transport losses“



ELP „Moisture when transporting goods“

Examples for the buildingblock „Cases of transport losses“



ELP „Moisture when transporting goods“

Examples for the buildingblock „Cases of transport losses“

UNASSISTED LEARNING

The container, Risk factor, Causes of transport loss, Humidity table

CAUSES OF TRANSPORT LOSS

Loss of strength

Corrosion

CAUSES | OXYGEN CORROSION | CORROSION CURVE | FINANCIAL LOSS

Whether or not corrosion causes a direct financial loss will depend on the use to which the steel is put.

Cold-rolled steel sheet
Cold-rolled steel sheets are hot-rolled sheets that have been further processed. Subsequent cold-rolling or finishing of the sheets increases their value by a factor of ten or more. These sheets have virtually no resistance against corrosion, and so considerable effort is invested in protecting them against corrosion prior to transport.

Hot-rolled steel
If hot-rolled steel that is to be subjected to extensive further processing rusts, a rust film is undoubtedly acceptable. But heavy corrosion as shown in the photo is no longer acceptable.

ELP „Moisture when transporting goods“

The screenshot shows a software interface with a navigation bar at the top containing icons for home, search, list, and book, and a train icon with navigation arrows. The main title is "PROTECTIVE MEASURES DURING TRANSPORT". Below the title are five trolley icons, each representing a different method:

- Desiccant method (trolley with bags)
- VCI method (trolley with rolls of material)
- Protective coating method (trolley with a metallic surface)
- Dunnage (trolley with white bags)
- General recommendations (trolley with a ship)
- Quiz (trolley with a checklist icon, highlighted with a red dashed circle)

A blue water drop character with a face is located in the bottom right corner of the interface.

ELP „ Moisture when transporting goods“

1. DESICCANT METHOD

1.1 Whereabouts in a barrier film do you think the best place to position desiccant bags is?

- Whenever possible in the top third, since water vapor has a lower density than air.
- Whenever possible near the floor, as condensation has a far greater density than air.
- Whenever possible in direct contact with the metallic surface to be protected.
- Whenever possible hanging freely, avoiding direct contact with the metallic surface.

1. DESICCANT METHOD

1.2 When visiting the packaging department on a factory tour after a weekend, you notice that exposed desiccant bags are to be used to protect a component that is susceptible to corrosion. Which of the following recommendations do you think you should urgently make?

- The desiccant bags must be replaced, as they are already saturated as a result of their being stored in an exposed position, and because they may give off water vapor, there is an even greater risk of corrosion for the component.
- The desiccant bags should be weighed and compared with the weight of the desiccant bags that are still stored in their original packaging. If the weights are not significantly different, the desiccant bags that have been exposed can still be used.
- There are no concerns about using the desiccant bags. A desiccant bag only becomes saturated after it has been stored for several weeks. Storing them for a few days after they have been unpacked is therefore not a problem.

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1. DESICCANT METHOD

1.1 Whereabouts in a barrier film do you think the best place to position desiccant bags is?

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- Whenever possible near the floor, as condensation has a far greater density than air.
- Whenever possible in direct contact with the metallic surface to be protected.
- Whenever possible hanging freely, avoiding direct contact with the metallic surface.

Assessment:

Correct: Desiccant bags should be placed hanging freely in the top third whenever possible.

1. DESICCANT METHOD

1.2 When visiting the packaging department on a factory tour after a weekend, you notice that exposed desiccant bags are to be used to protect a component that is susceptible to corrosion. Which of the following recommendations do you think you should urgently make?

- The desiccant bags must be replaced, as they are already saturated as a result of their being stored in an exposed position, and because they may give off water vapor, there is an even greater risk of corrosion for the component.
- The desiccant bags should be weighed and compared with the weight of the desiccant bags that are still stored in their original packaging. If the weights are not significantly different, the desiccant bags that have been exposed can still be used.
- There are no concerns about using the desiccant bags. A desiccant bag only becomes saturated after it has been stored for several weeks. Storing them for a few days after they have been unpacked is therefore not a problem.

Assessment:

Correct: The desiccant bags must be replaced.

ELP „Moisture when transporting goods“


The buildingblock „Protective Measures during Transport “

Home, Search, Share, Bookmarks, Cart, Previous, Next

Desiccant method ⁱ

FUNCTION **TYPES** **USE AND EXAMPLE** **EVIDENCE OF EFFECTIVENESS** **PROS AND CONS**

This video illustrates all the steps involved in using the desiccant method.



Using the desiccant method

ELP „Moisture when transporting goods“

The buildingblock „Protective Measures during Transport “



play video 03 dessicant



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Humidity management during the transports of goods

This interactive e-learning programme (ELP) addresses humidity management during the transports of cargoes. It consists of six units which consider different factors that are important to successfully prevent losses occurring due to humidity.

[Read more >](#)



Important Note:

The E-Learning-Program

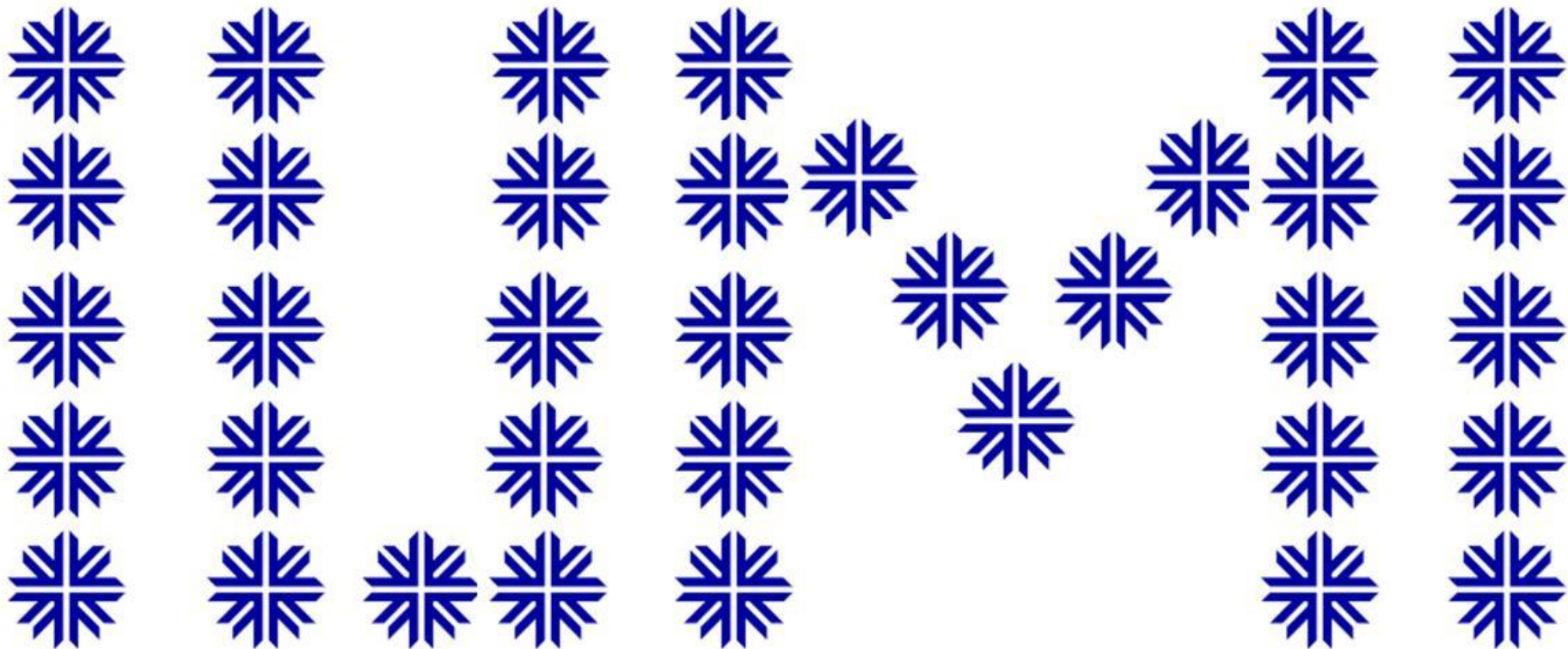
**http://www.tis-gdv.de/tis_e/e_learn/index85094.html
„Moisture when transporting Goods“**

is only optimised for Firefox



**For the program to work correctly,
please ONLY use Fire Fox**

Q & A





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