

# Mold Formation in Cathedral Ceilings: Hygrothermal Analysis and Solutions

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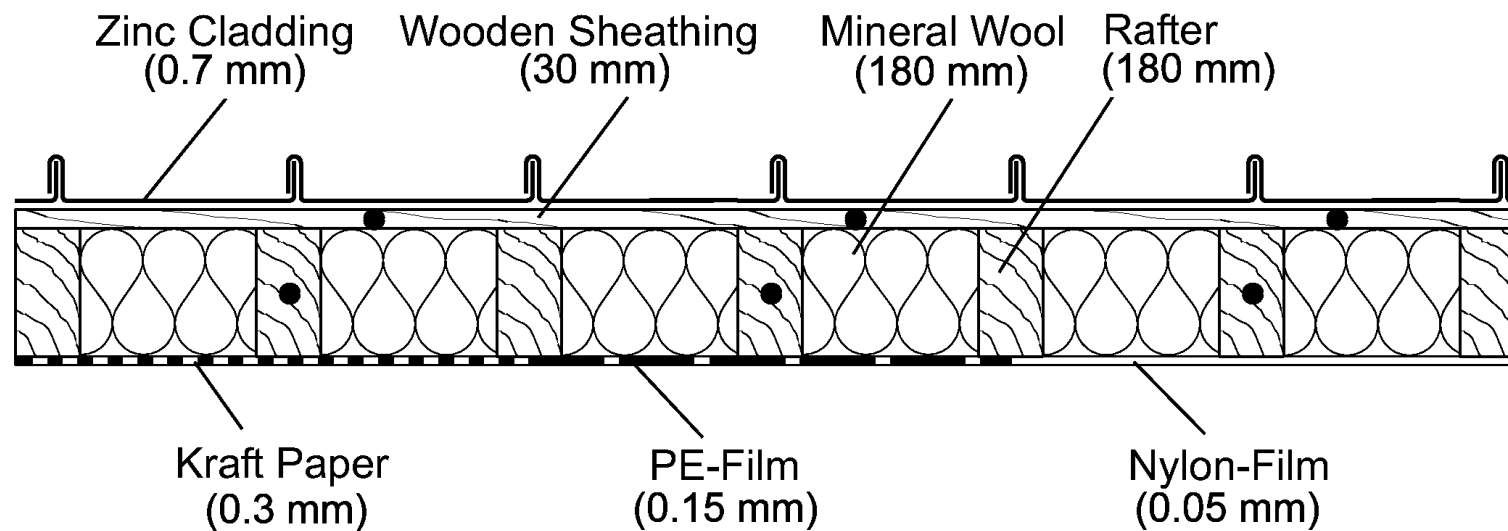
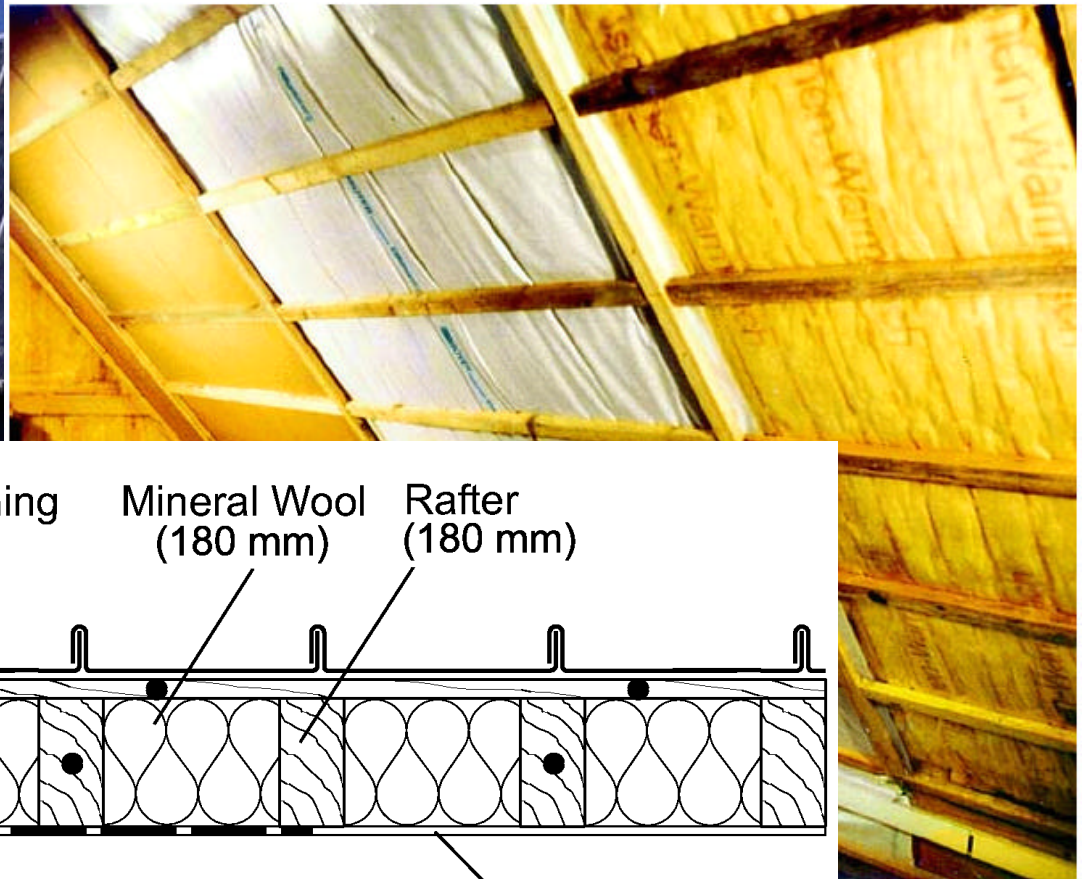
- Problem: mold detected during a field test
- Analysis of the hygrothermal conditions
- Biohygrothermal model for mold prediction
- Conclusions

# Field Test Site in Holzkirchen





# Cathedral Ceiling with Metal Sheet Covering



- Moisture Sensors

**Mold growth due to  
summer condensation**

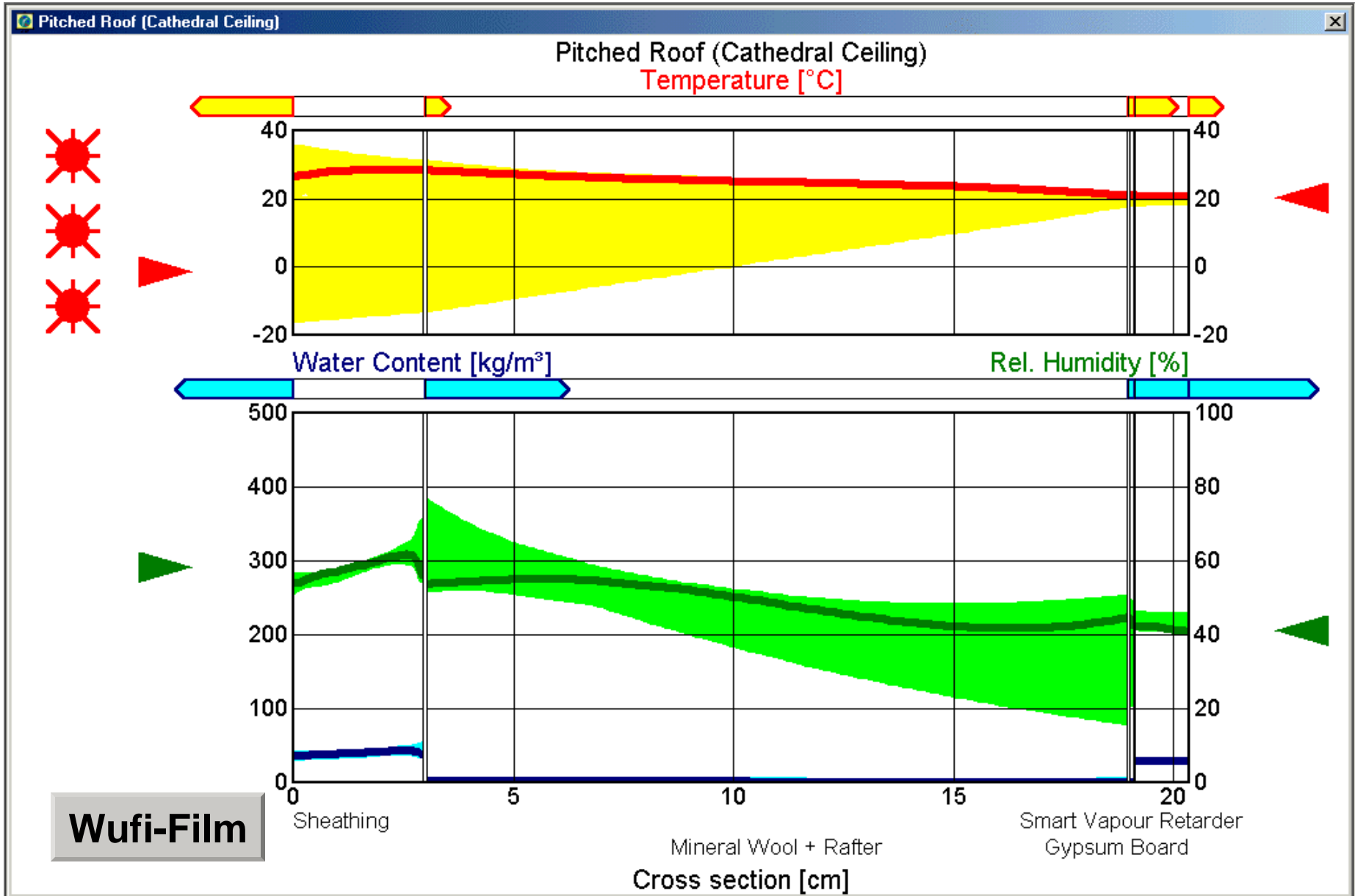


**No Mold growth  
on PA-Film**

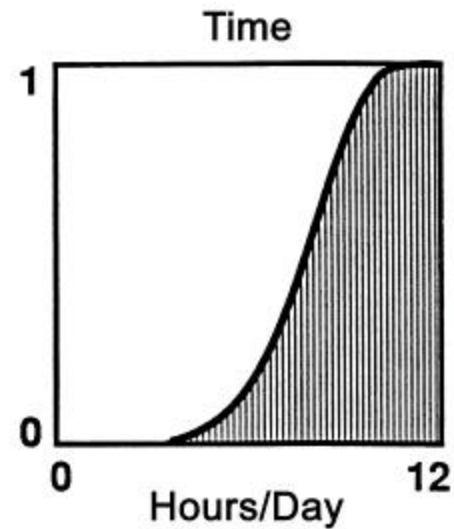
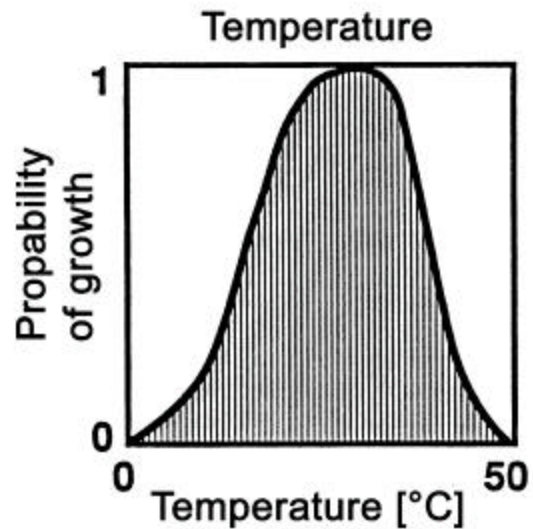
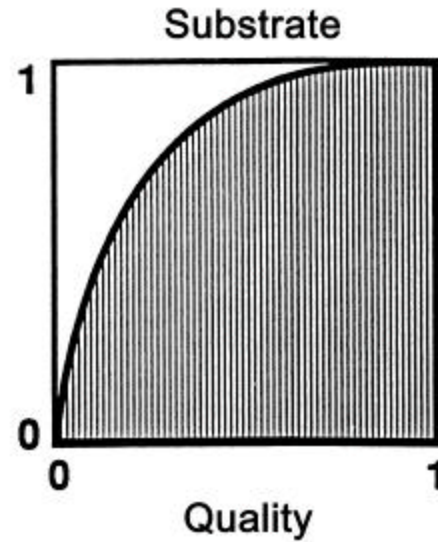
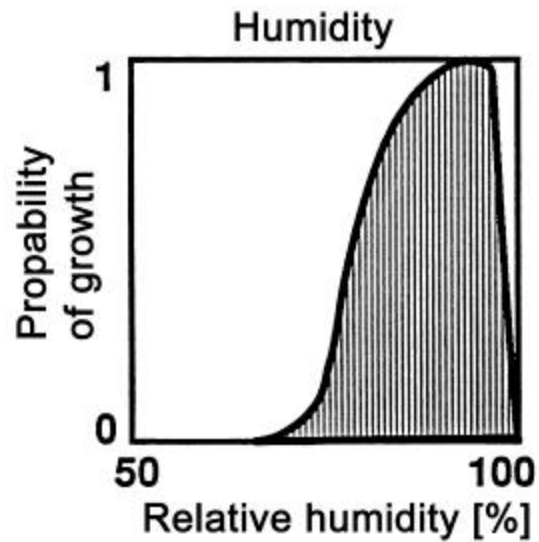




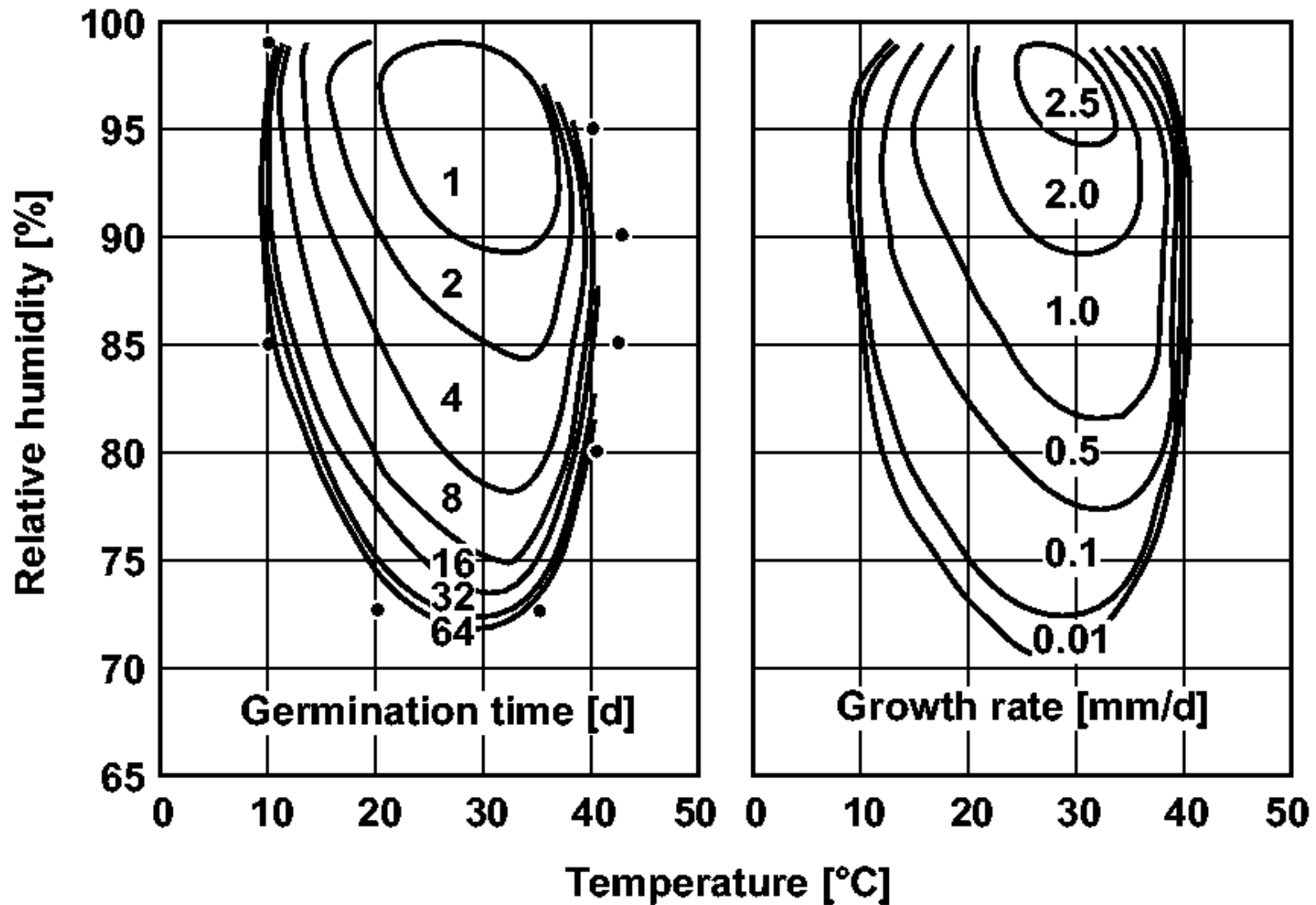
# Computational Analysis of the Hygrothermal Conditions



# Factors Favoring Mold Growth



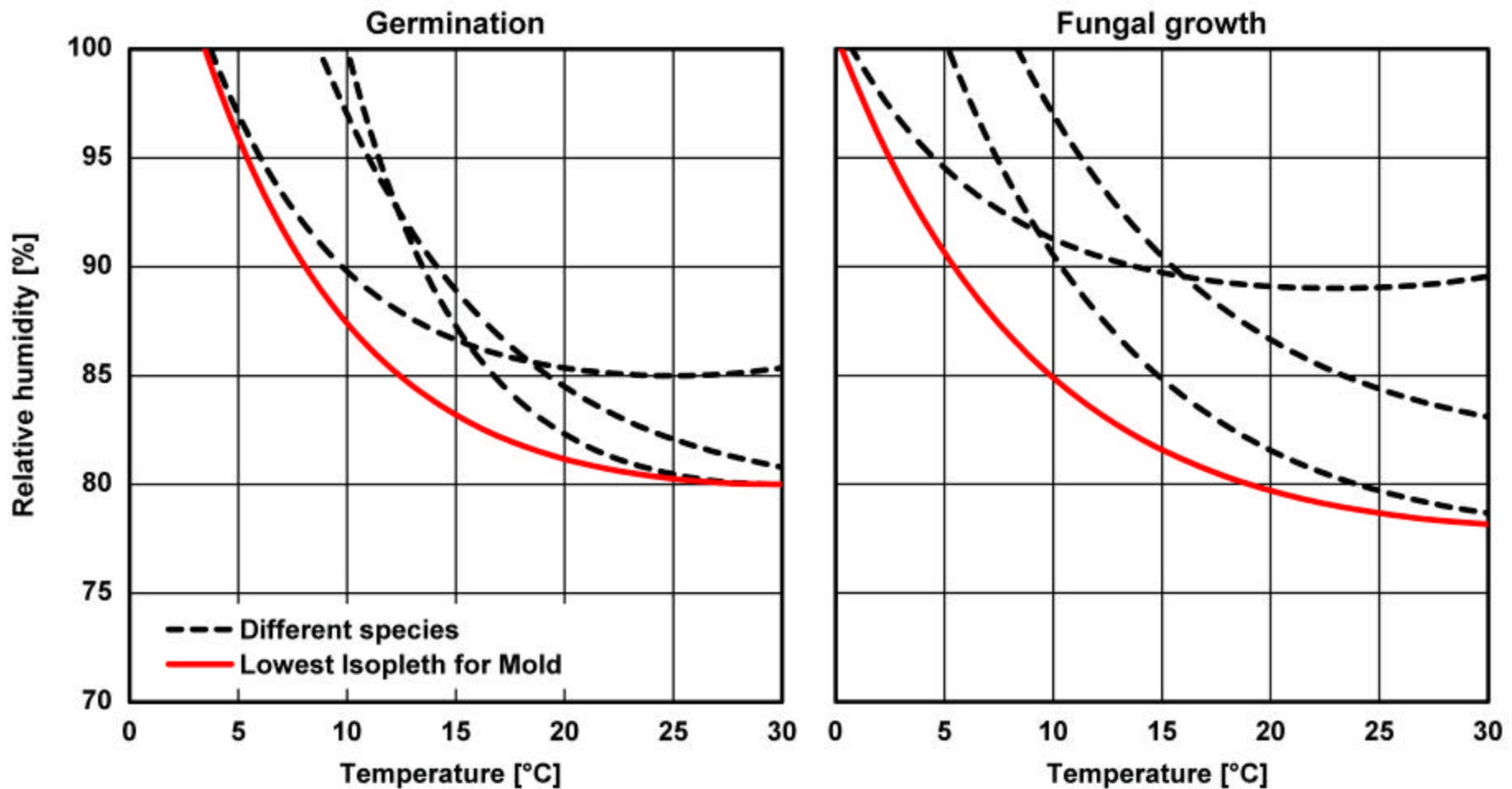
## *Aspergillus restrictus* (Smith)



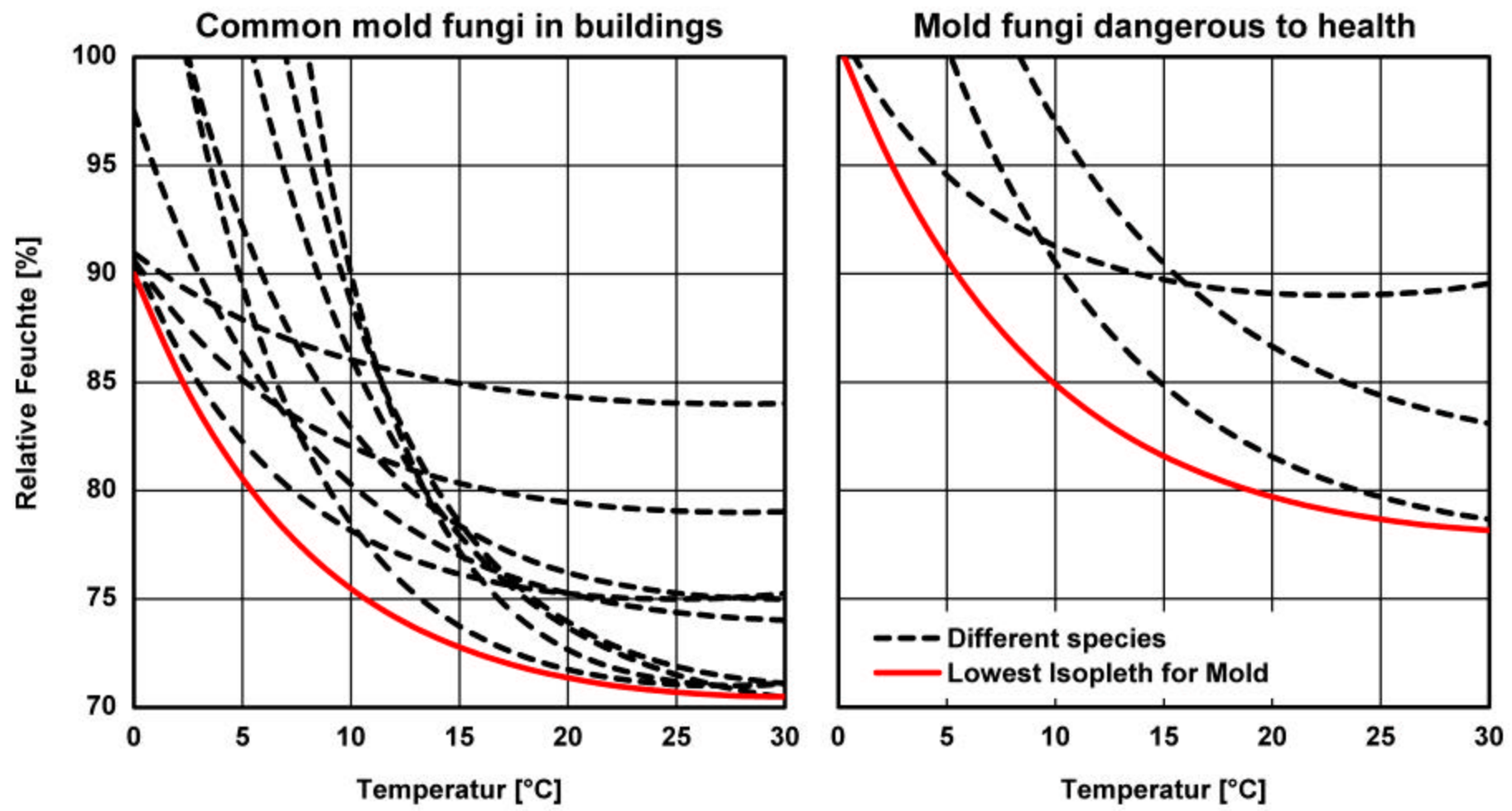


# Development of the Lowest Isopleth for Mold

Mold fungi considered as dangerous to health:  
(*Aspergillus fumigatus*, *Aspergillus flavus*, *Stachybotrys chartarum*)

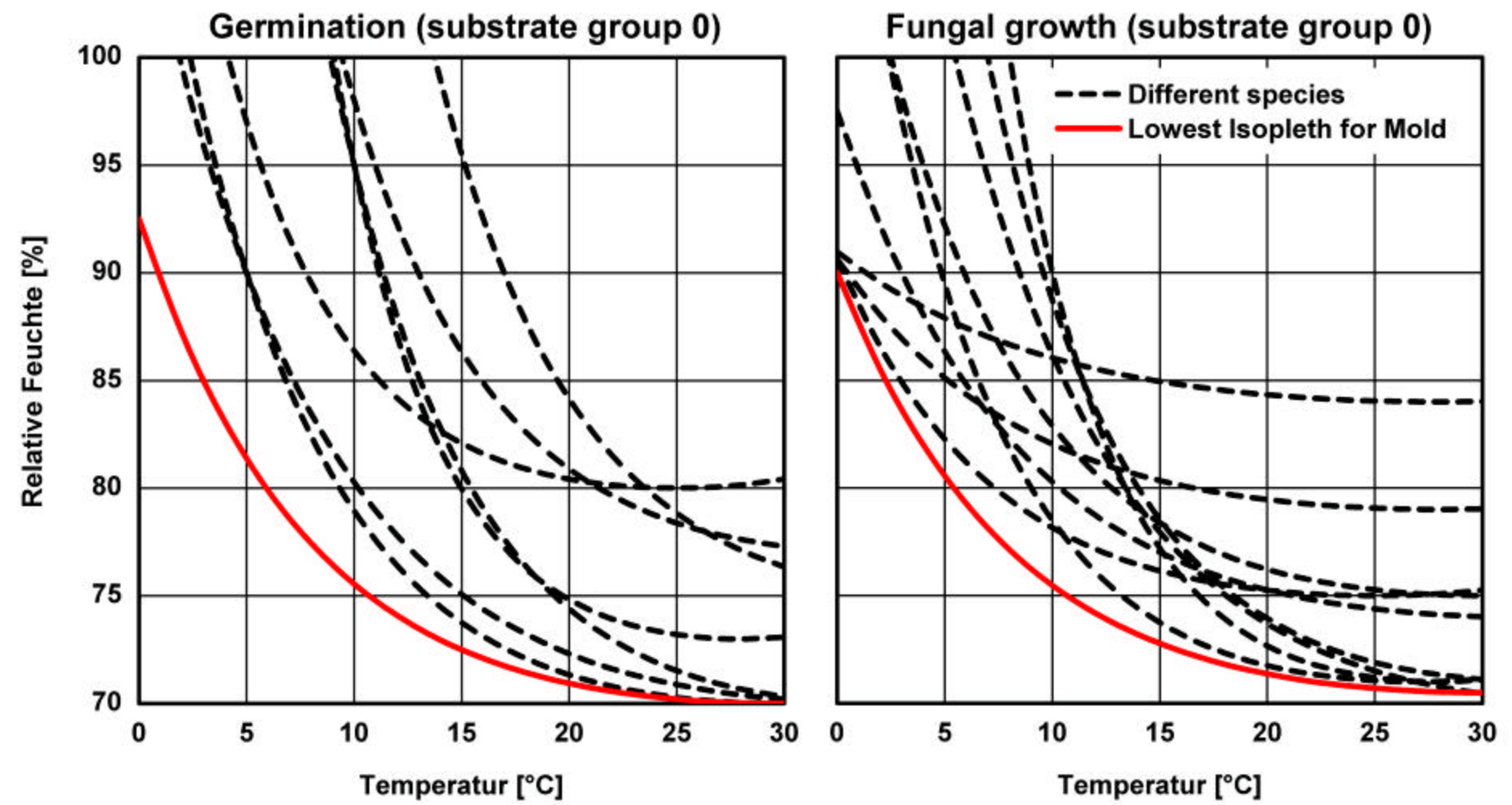


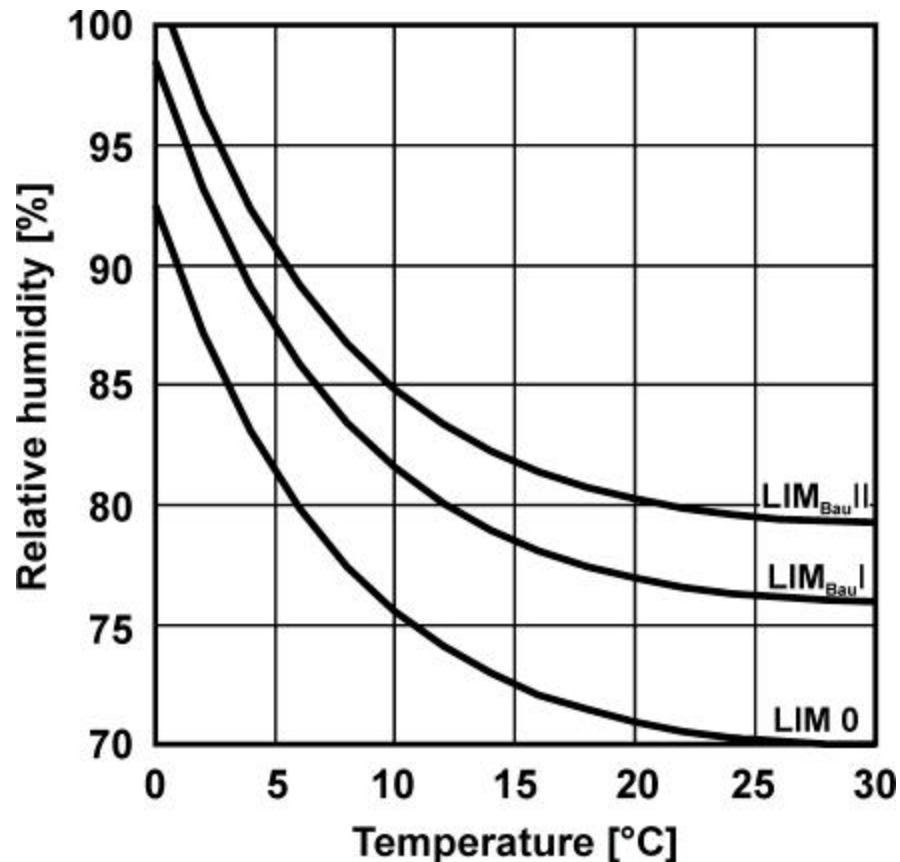
# Development of the Lowest Isopleth for Mold



Fortunately higher humidity necessary for mold with health risk

# Development of the Lowest Isopleth for Mold

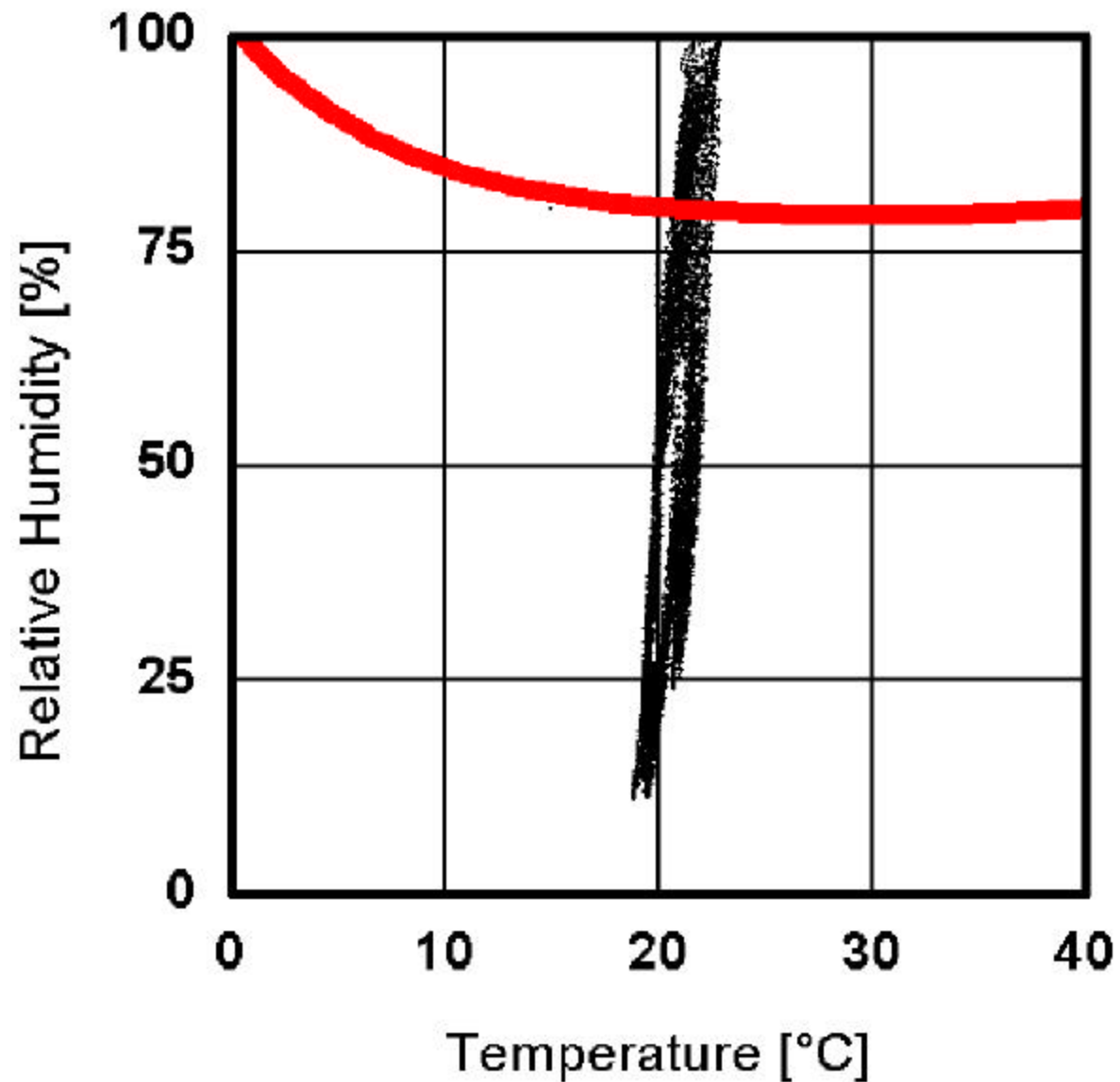




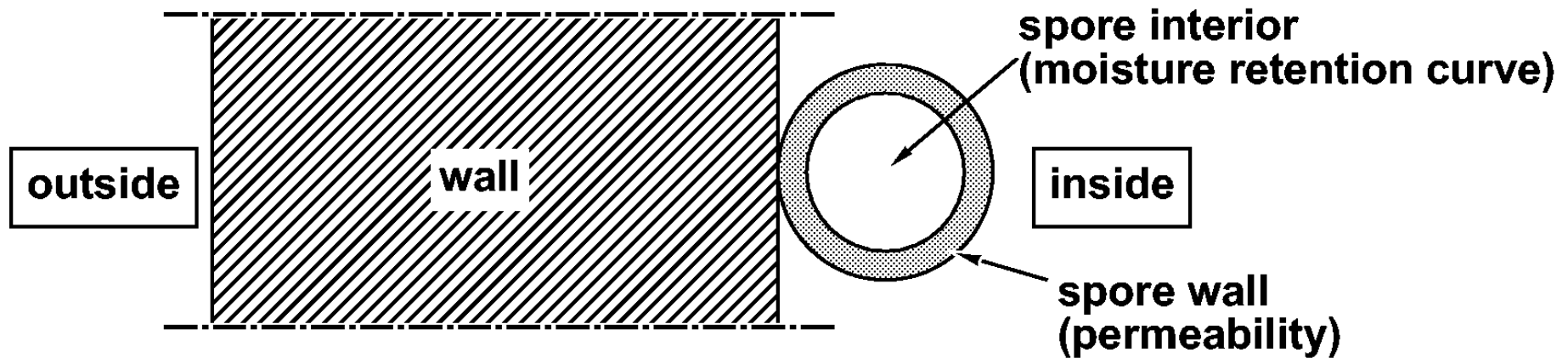
## Substrate group:

- 0 optimum substrate  
(biological full medium)
- I biodegradable substrates  
(wood, wall paper, ...)
- II non biodegradable substrates  
(mineral building materials)

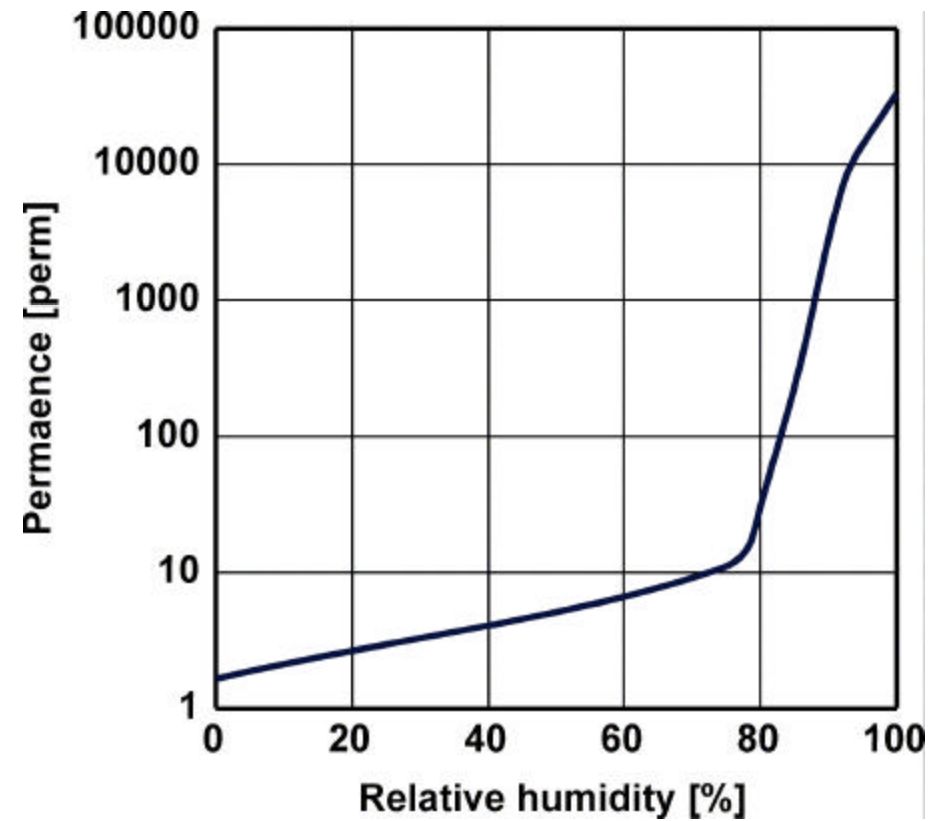
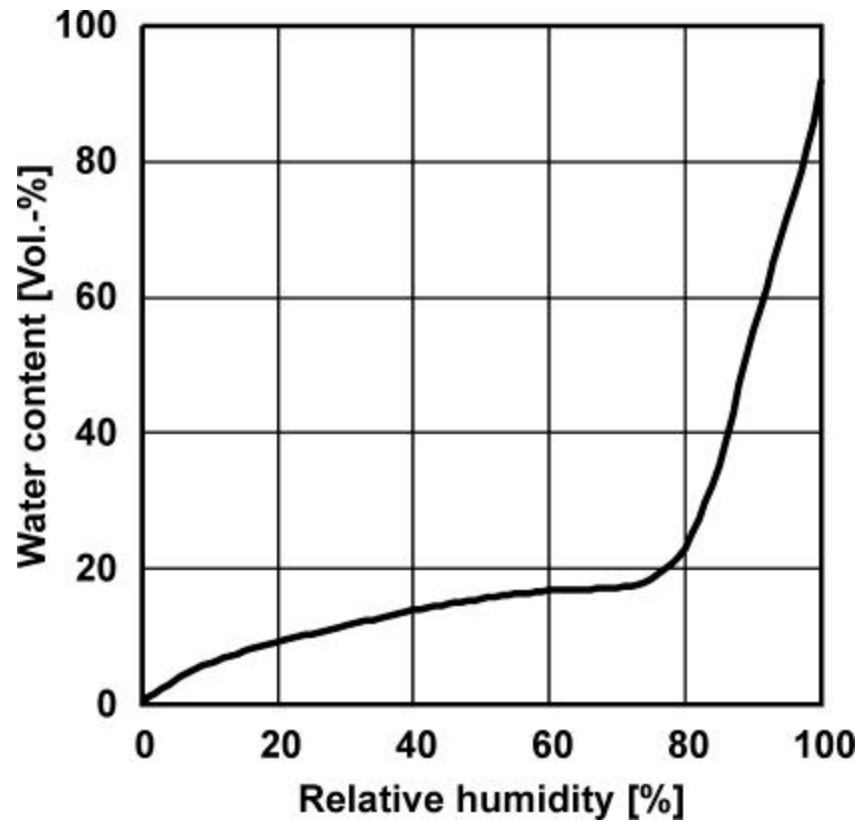




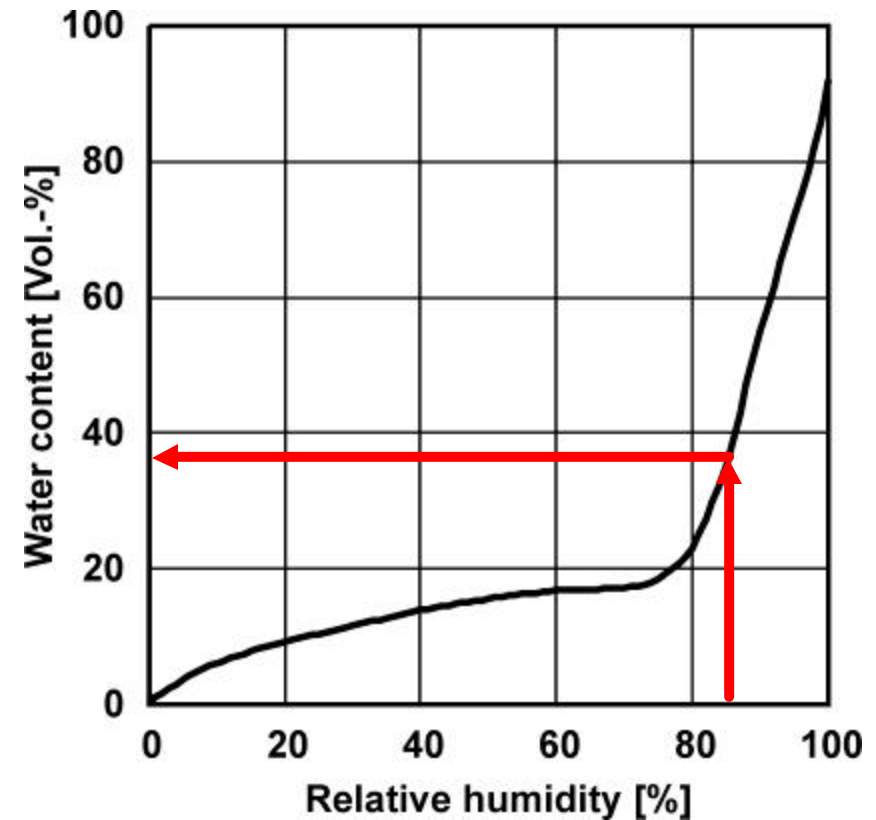
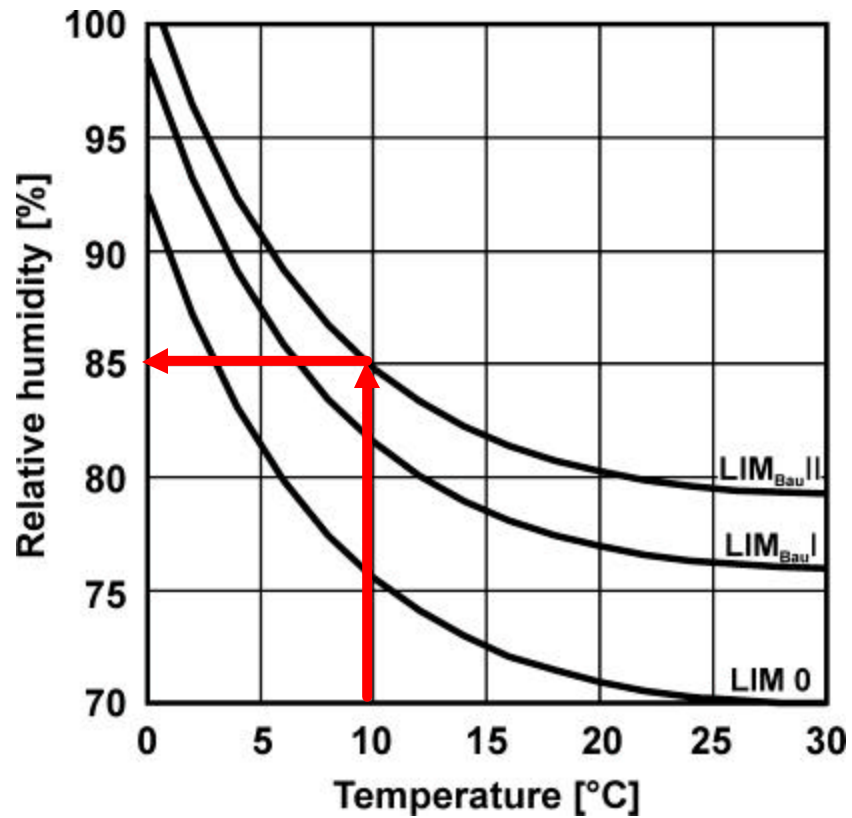
## model spore



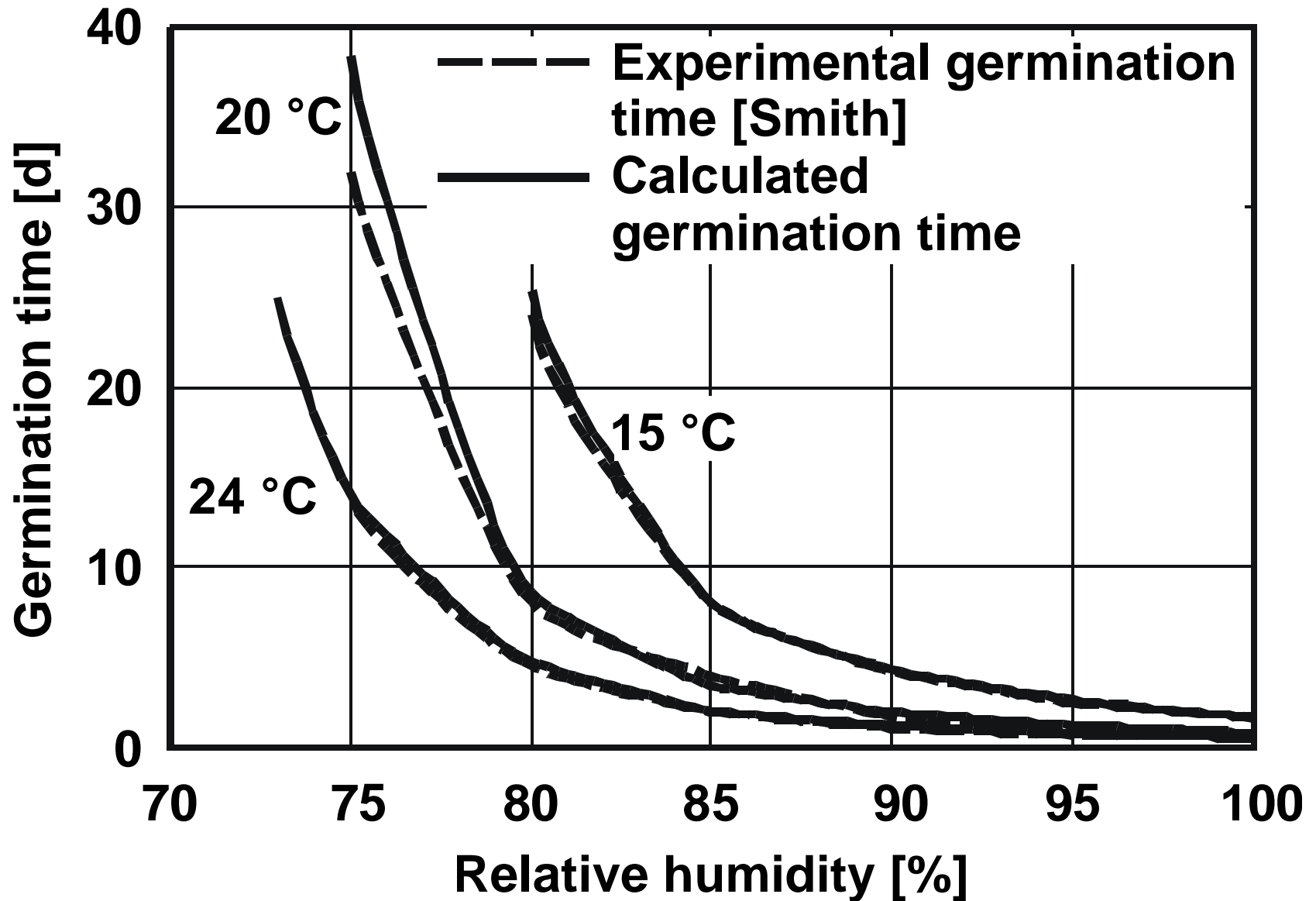
# Hygrothermal Characteristics of the Model Spore



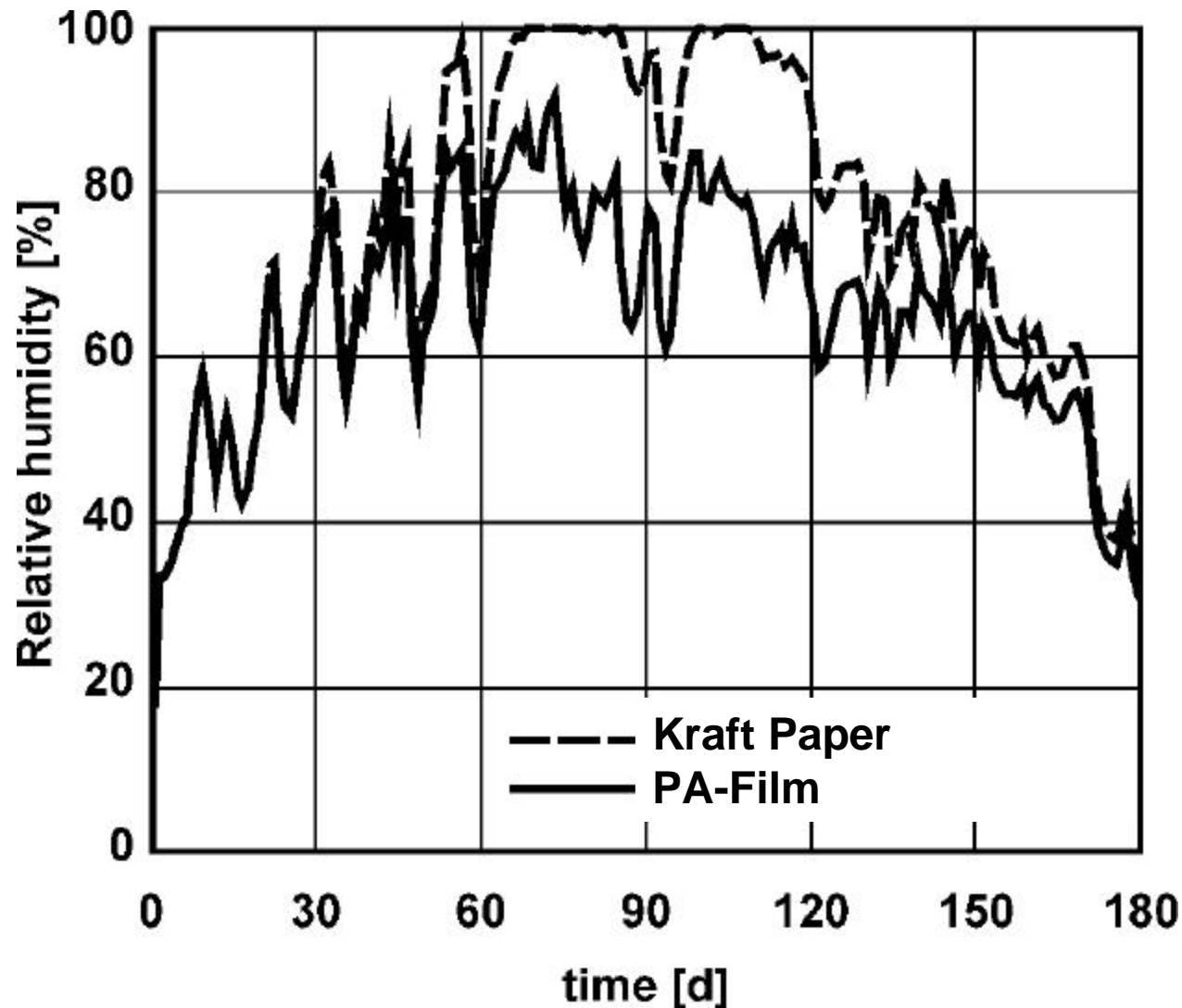
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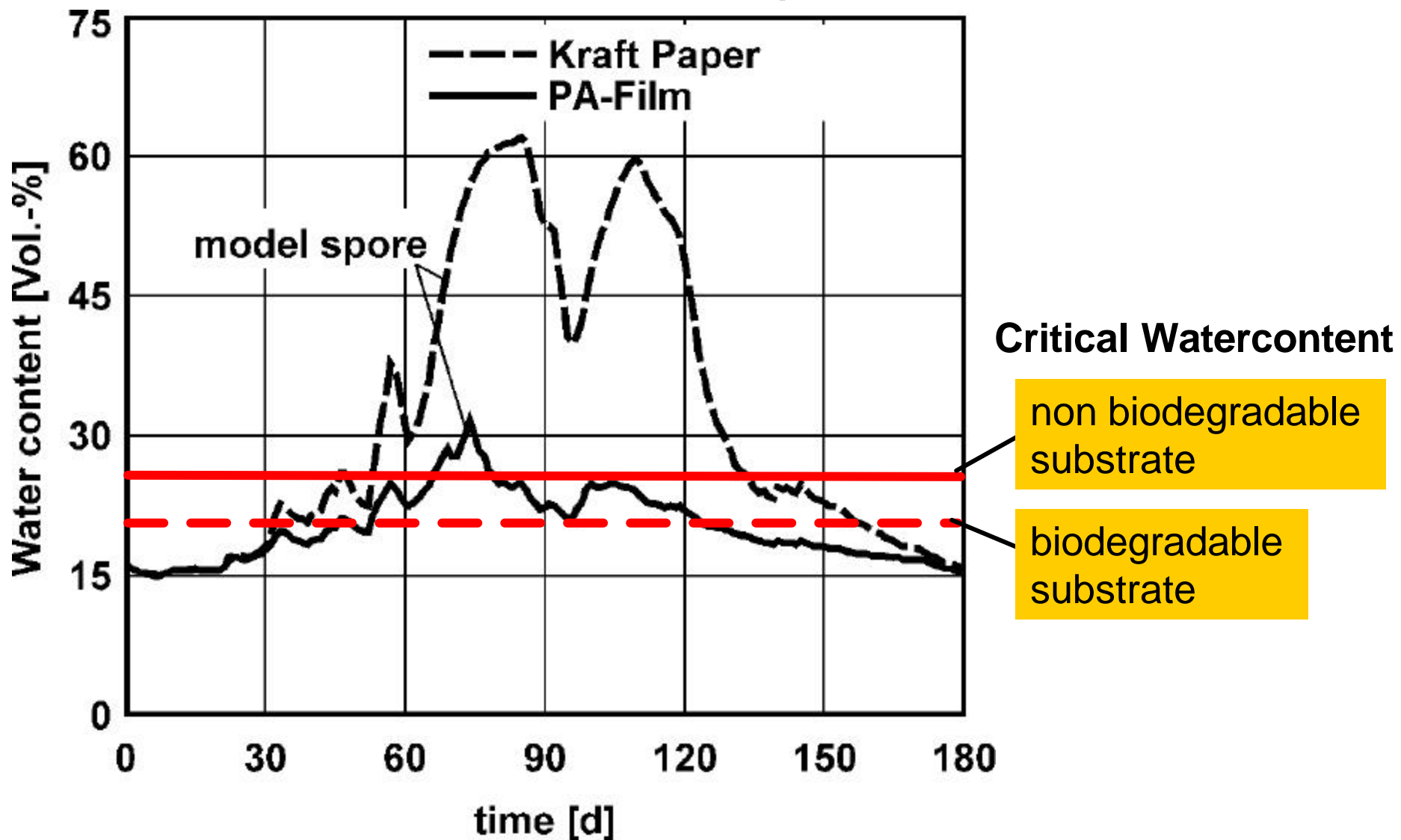




## Humidity Behind the Vapor Retarder



Water Content of the Model Spore



Summer condensation may lead to mold formation in the building envelope

### Remedies:

- reduce moisture intrusion
- enhance drying potential
- avoid biodegradable materials in condensation planes

### Mold growth predictions for fluctuating hygrothermal conditions

- new biohygrothermal model looks promising
- more research necessary to validate this model



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Diss Sedlbauer

Biohygrothermal model  
WUFI-Bio (only in German)