JUSTIFICATIONS for HEPA FILTER SERVICE LIMITS under ADVERSE OPERATING CONDITIONS related to MOISTURE EXPOSURE

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Prologue

"The health of nations is more important than the wealth of nations.“

— *Will James Durant*

1885 – 1981 CE

Introduction

- proposed limits on the service of filters exposed to moisture, or with the ***potential for exposure*** to moisture, call for:
  - prompt removal from service, or
  - ***stricter limitations*** on service life

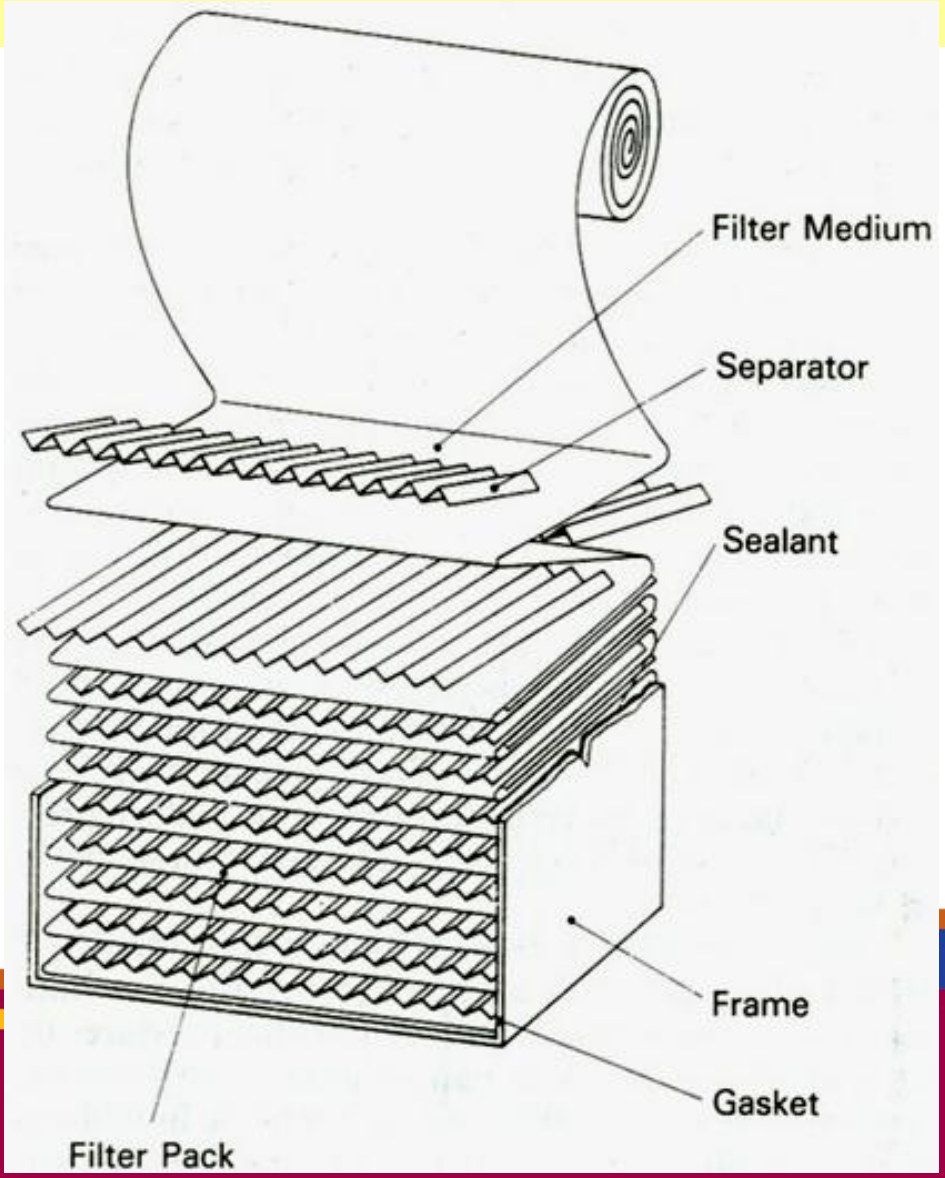
Need

- reliability of current HEPA filter designs limited by characteristics of glass-fiber filter media (fm)
- reinforcement* of filter medium does *not* fully address the adverse effects of most factors

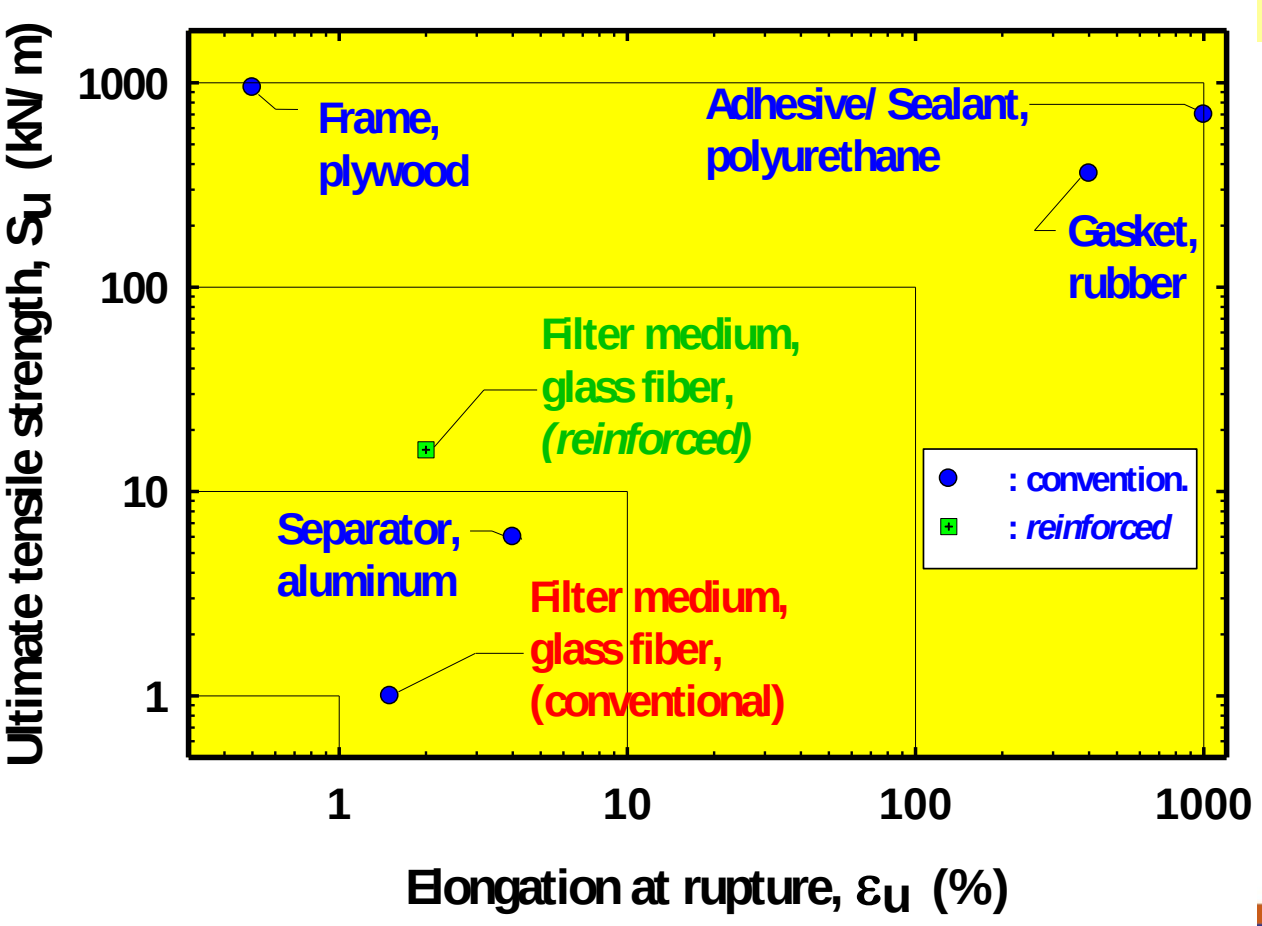
Benefits of Service Guidelines

- provide users with guidance to help ensure HEPA-filter reliability during service life technically/economically
- help enhance overall reliability of safety-related air cleaning systems

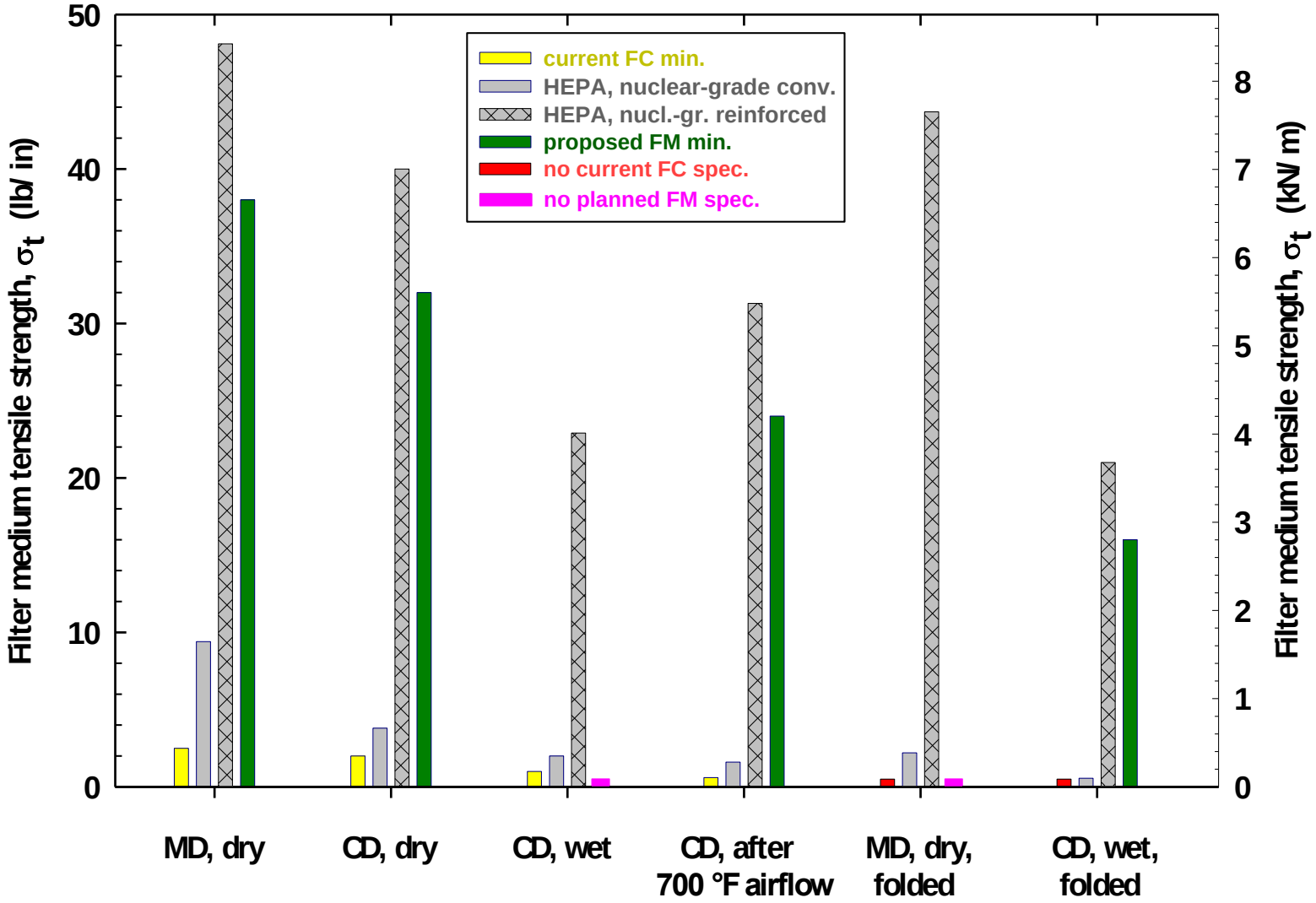
Deep Pleat Axial-Flow Filter



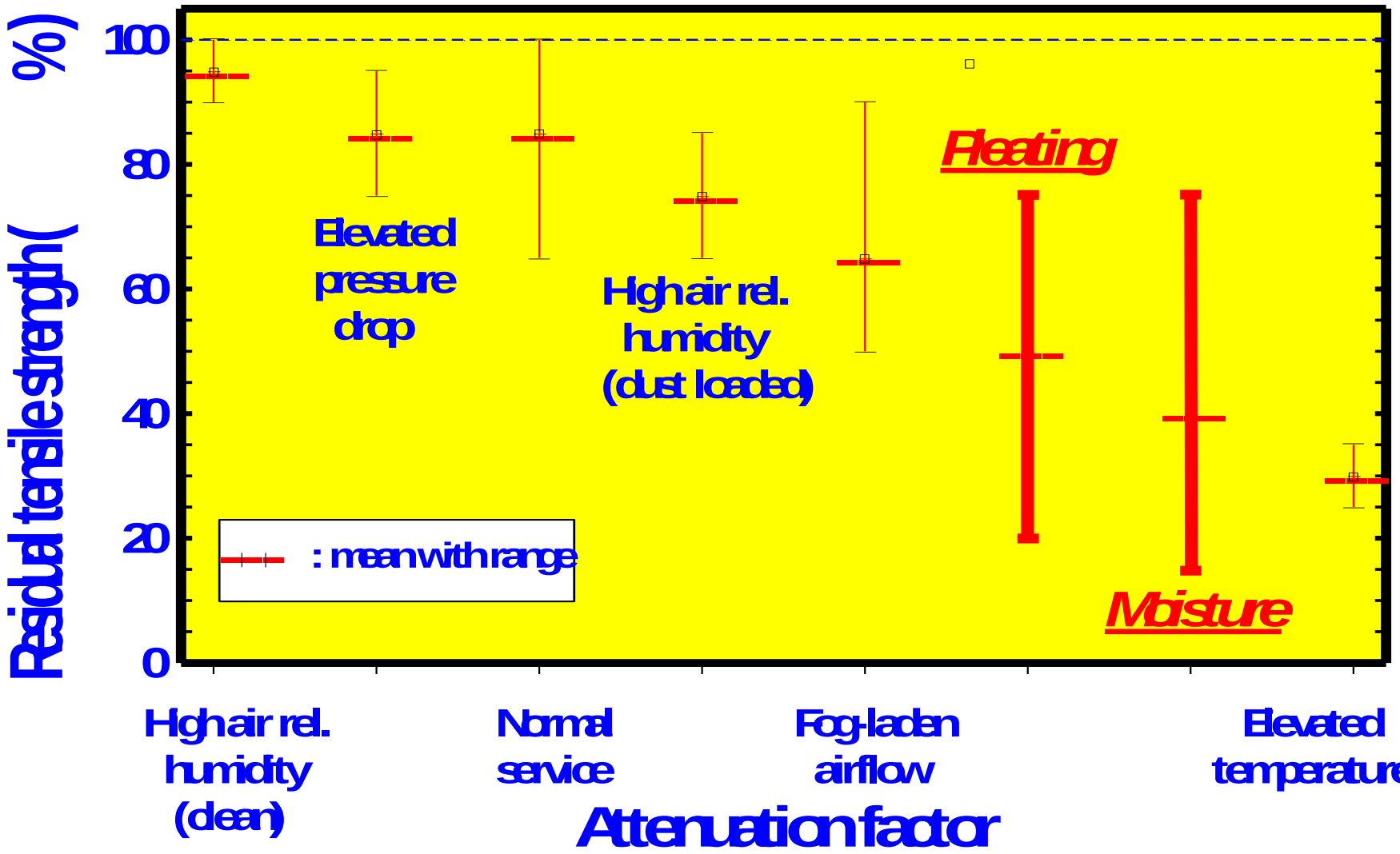
Comparison of Mat. Properties



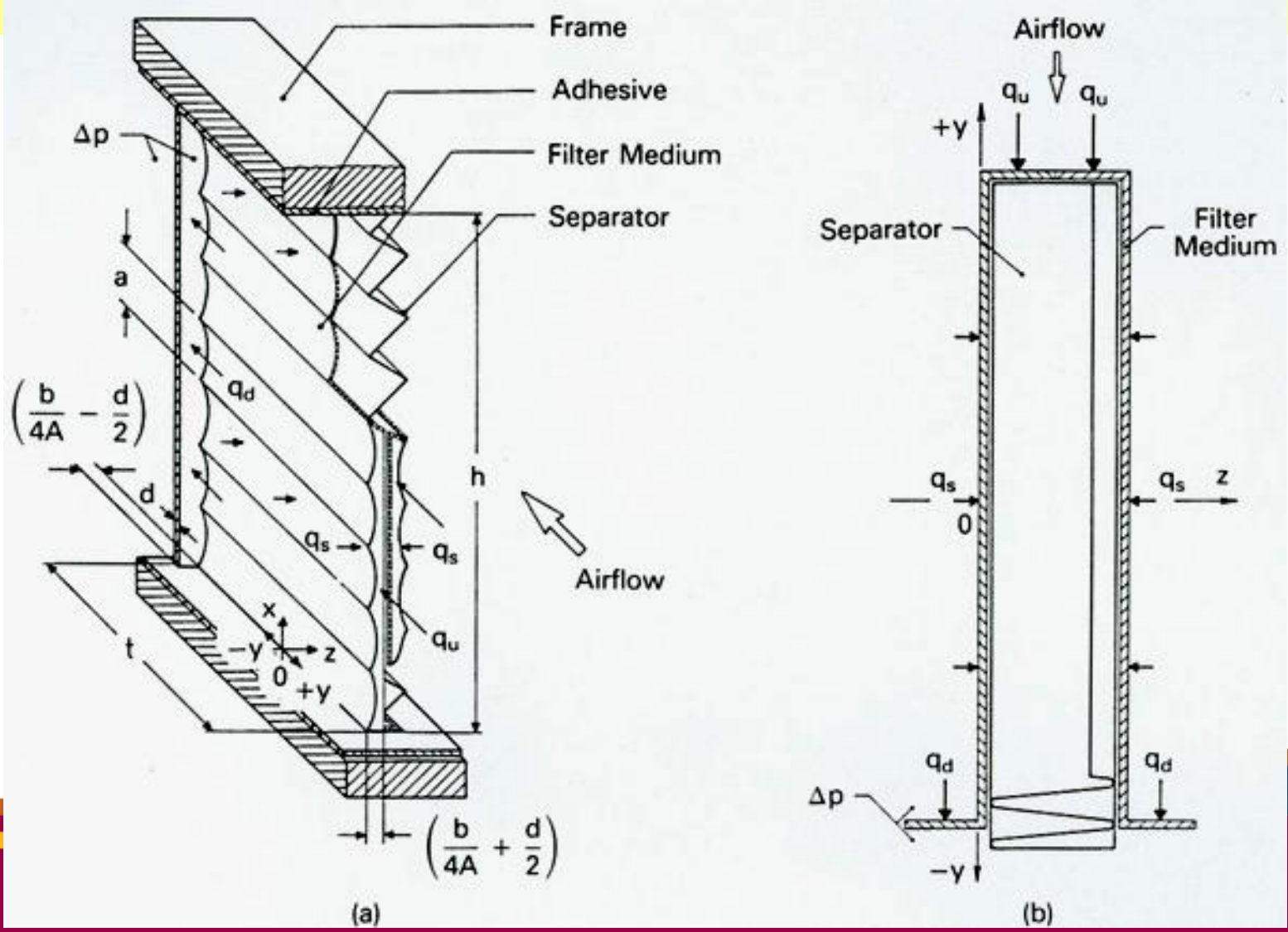
Tensile Strength Comparisons



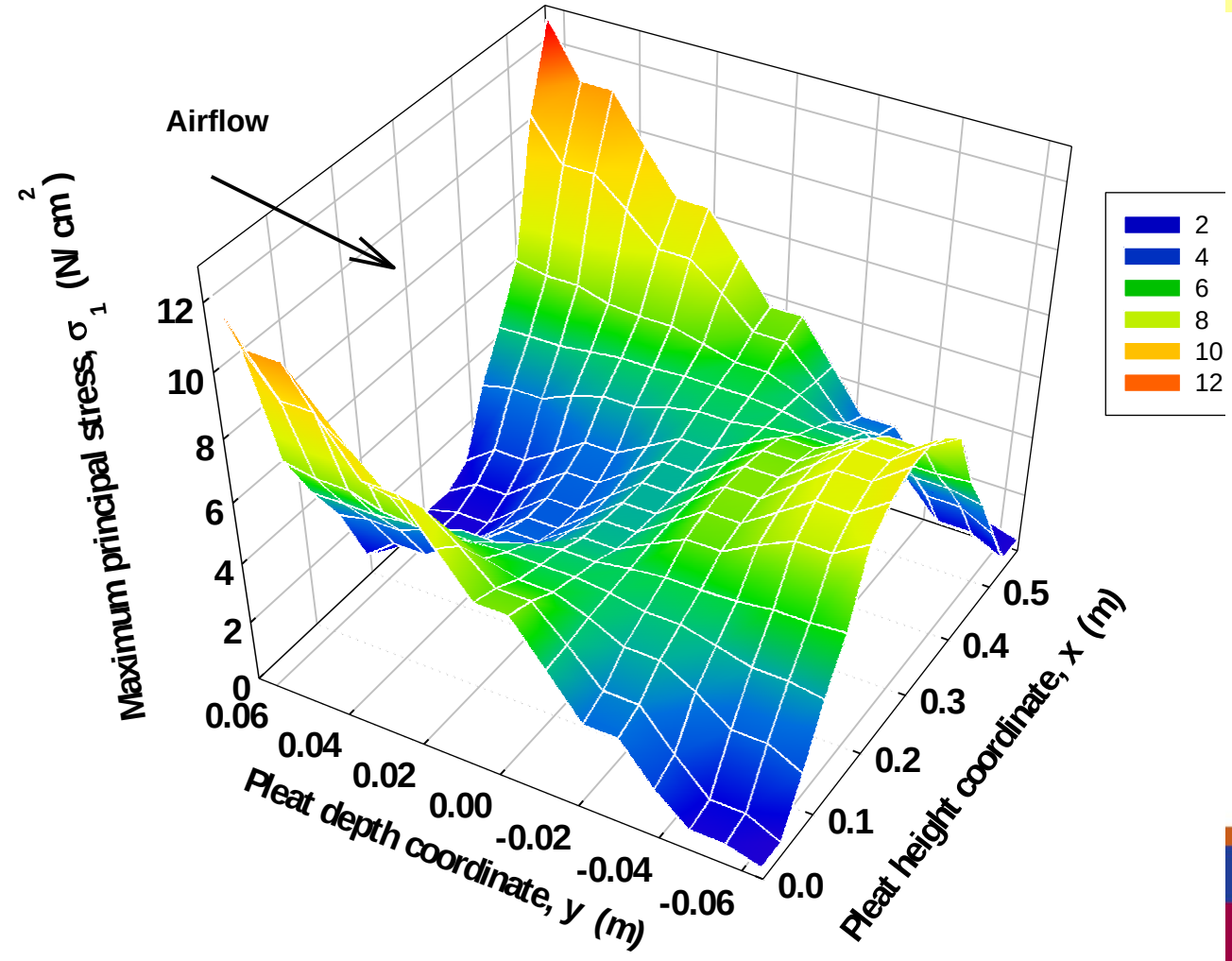
Filter Medium Residual Strengths



Deep Pleat Geometry

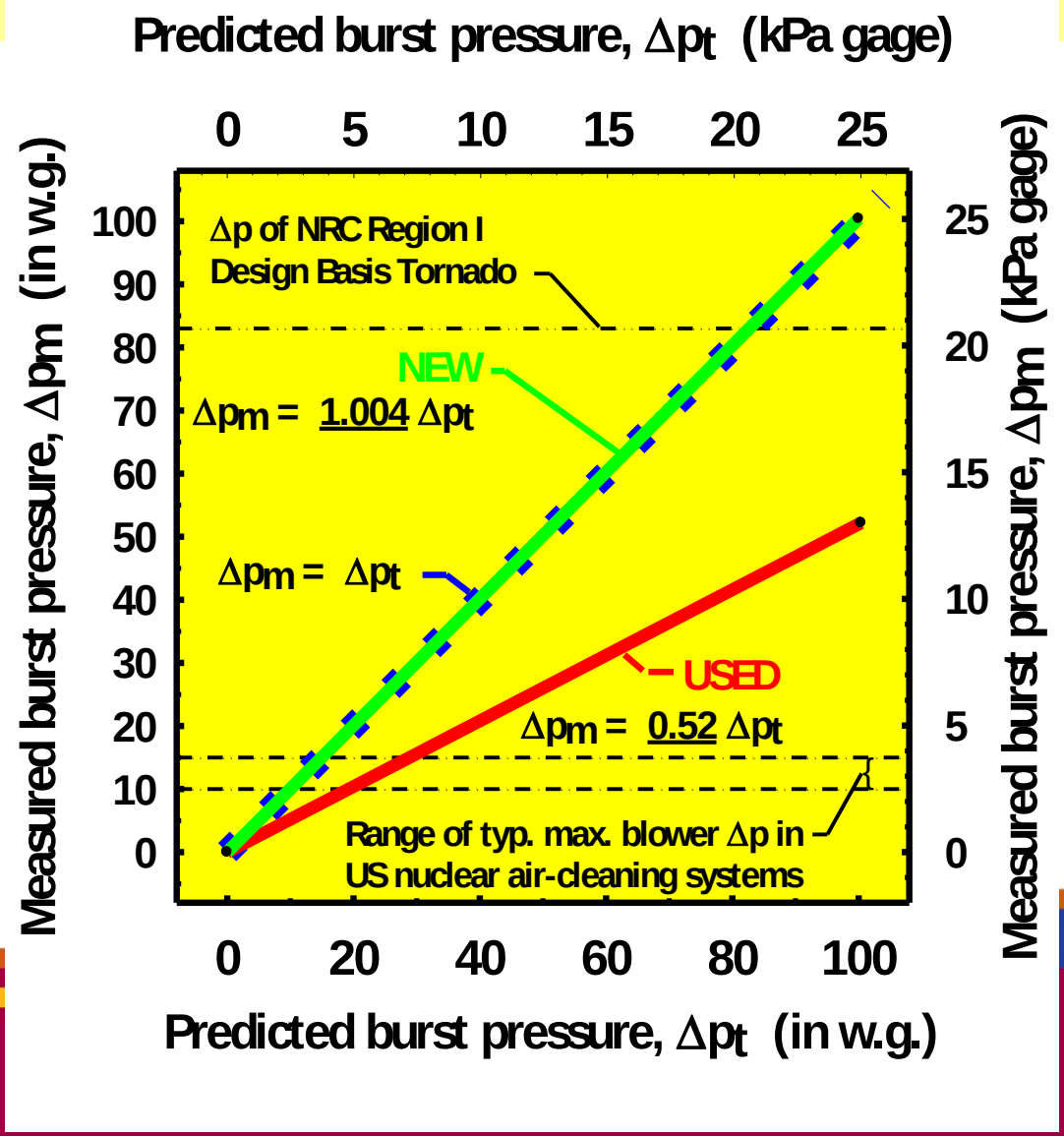


Stress Distributions (typ)



(b)

Fatigue of Filter Medium



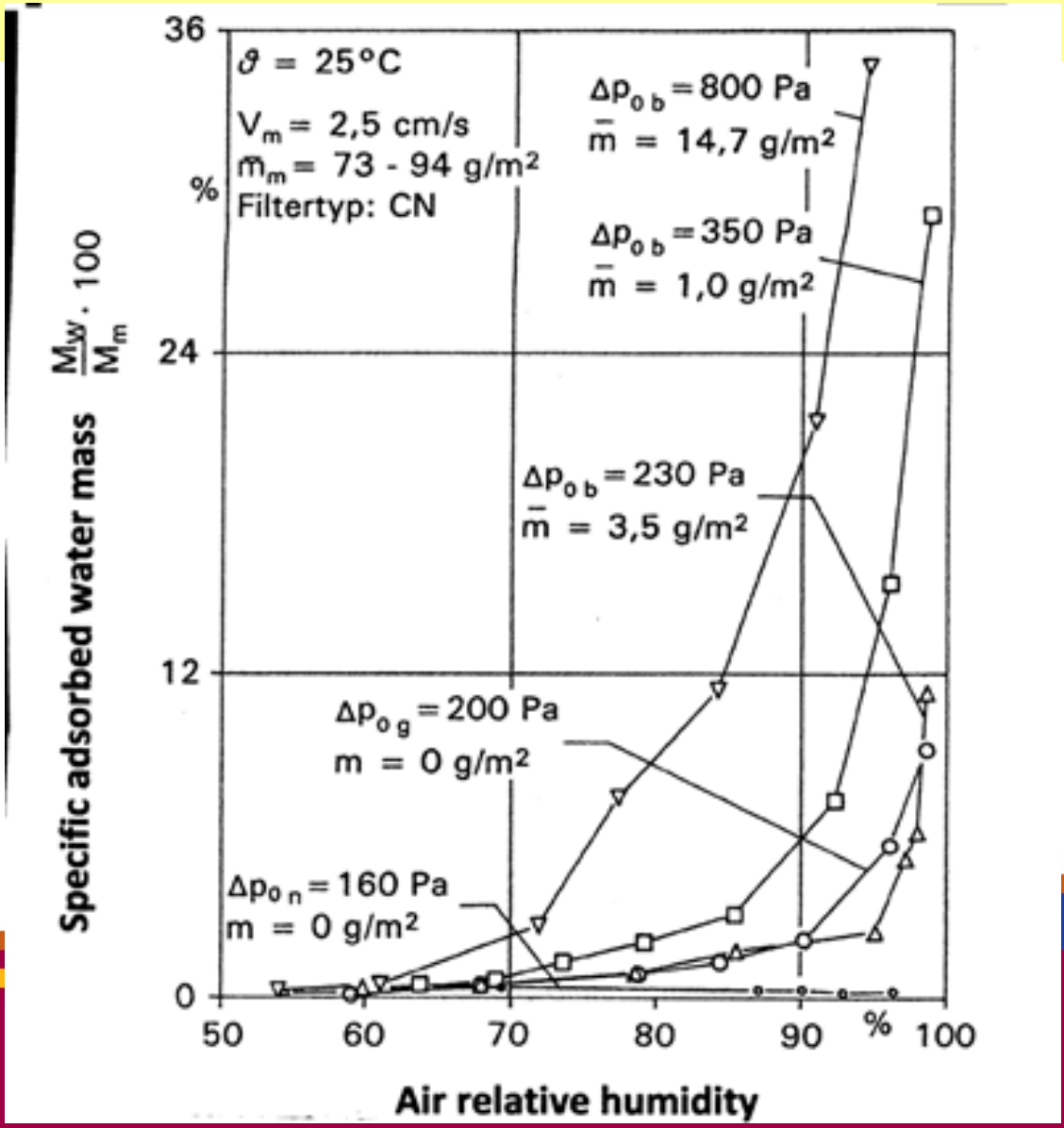
Filter Medium Characteristics (gf)

- 0.5-mm thick
- very low tensile strength*
- fragile, brittle, *and* anisotropic material
- *extremely* sensitive to H_2O exposure
- susceptible to fatigue and ageing effects

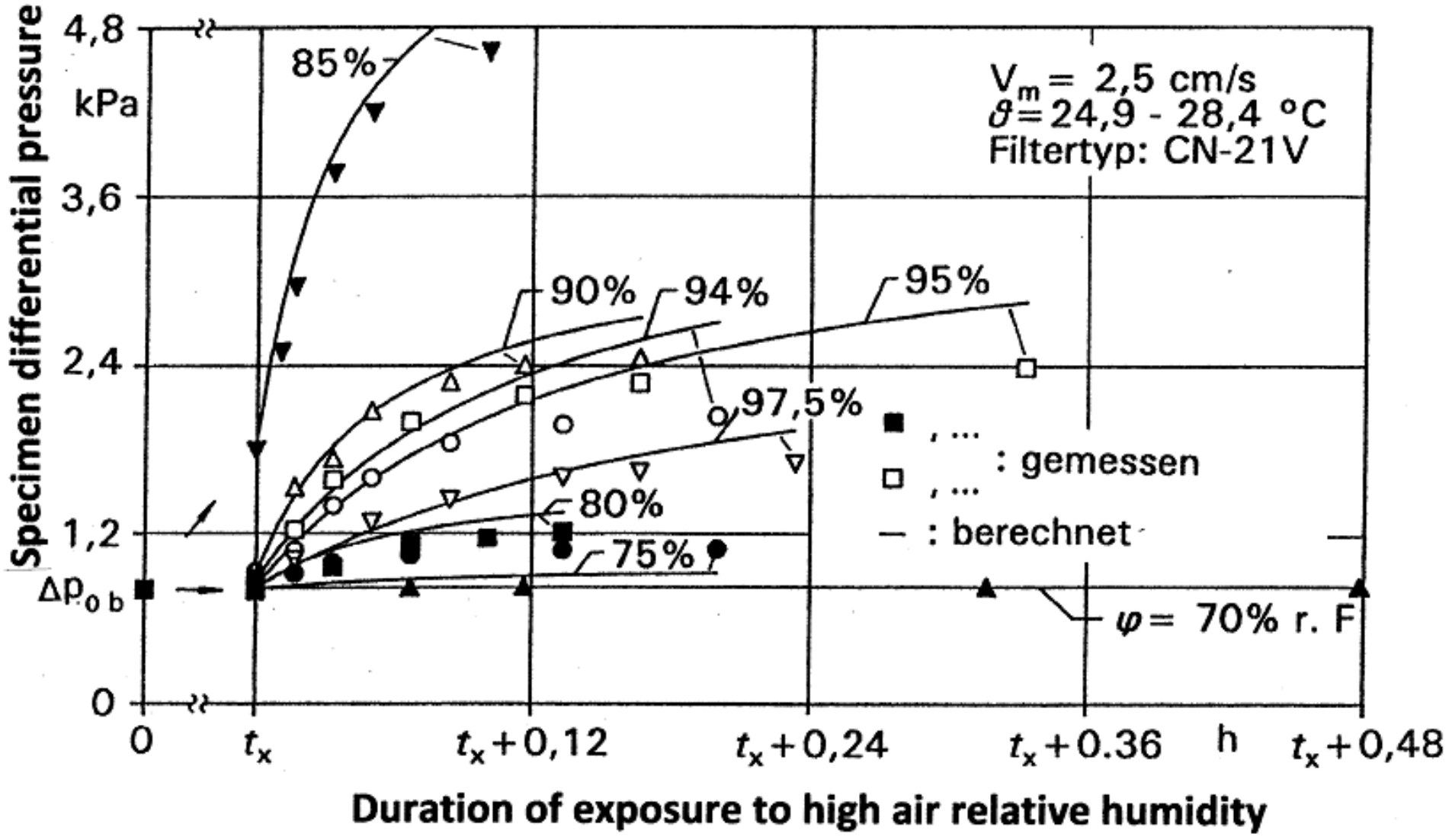
Filter Limitations (via fm char.)

- risk of filter-pack catastrophic failure*
- exposure to liquid water leads to:
  - penetration by water sol. substances
  - increase in differential pressure
  - significant decrease in burst strength*

Medium Adsorption Isotherms



Humidity-Induced Δp Increases



Conclusions

- proposed limits on the service of filters exposed to moisture are warranted

- an alternative to the proposed service-limit guidelines would be an *in place* test of filter medium residual mechanical robustness

Acknowledgments

- Published and unpublished works of Dr. W. Bergman that supports the implementation of recommendations for limits on service life and for service limits under adverse operating conditions related to moisture exposure.

Thank You

for Your kind attention.

Questions?

Epilogue

The Keys to a Real and Robust Nuclear Safety Culture

Integrity – The commitment to ultimately protect the safety of the general public even when it is not politically or economically in the interest of the existing management structure …

– Keith Jason Maxwell 2014 CE