CRC for Premium Quality Wool

Fibre Properties & Final Products

Produced for the CRC for Premium Quality Wool undergraduate program by;
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Dr. Peter Auer, The University of New South Wales.

Contributors to Fabric Properties

- Fibre properties
- Yarn construction
  - twist
  - doubling
- Fabric Construction
  - woven / knitted
  - weave / knit structure
- Finishing
  - milling
  - setting

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Classification of Fabric Characteristics

- Aesthetic
  - Fabric Handle
  - Prickle
  - Thermal Insulation
  - Wrinkle Recovery
  - Pilling
  - Appearance in Wear
  - Colour
- Functional
  - Fabric Strength
    - Tear
    - Tensile
  - Shrink Resistance
  - Abrasion Resistance
  - Ease of Manufacture
  - Flame Retardance
  - Water Repellency

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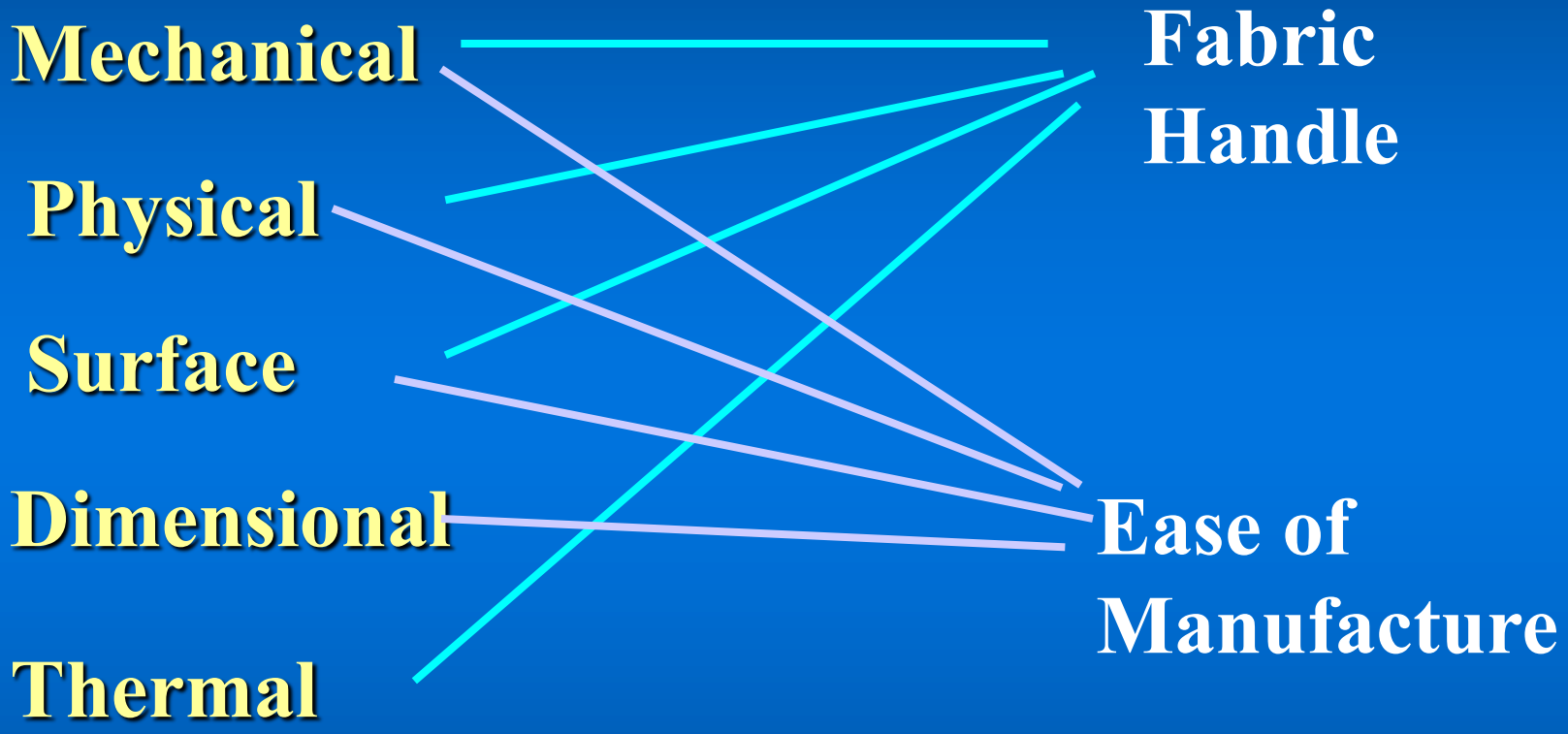
Contributing Factors



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Fabric Properties

- Low Stress Mechanical
  - Extensibility
  - Bending Rigidity
  - Shear Stiffness
  - Lateral Compressibility
  - Recovery from above deformations
- Physical
  - weight
  - thickness
  - fabric construction

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Fabric Properties

- **Surface**
  - surface friction
  - surface geometry
- **Dimensional**
  - relaxation shrinkage
  - hygral expansion
- **Thermal Insulation**
  - thermal flux

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Fibre Effect - Mechanisms

- direct
  - prickle
  - pilling
- modification of fabric structure
  - fabric thickness
  - weave crimp
- modification of fabric mechanical properties
  - bending rigidity
  - shear properties

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Objective Description of Fabric Handle

- FUKURAMI soft, bulky vs. cold, hard
- KOSHI stiff vs. limp
- NUMERI soft, smooth vs. hard, rough
- HARI anti-drape stiffness
- SHARI crispness

- Total Hand Value THV (objective)
  - combines all the above
  - regression equation
  - specific fabric ranges

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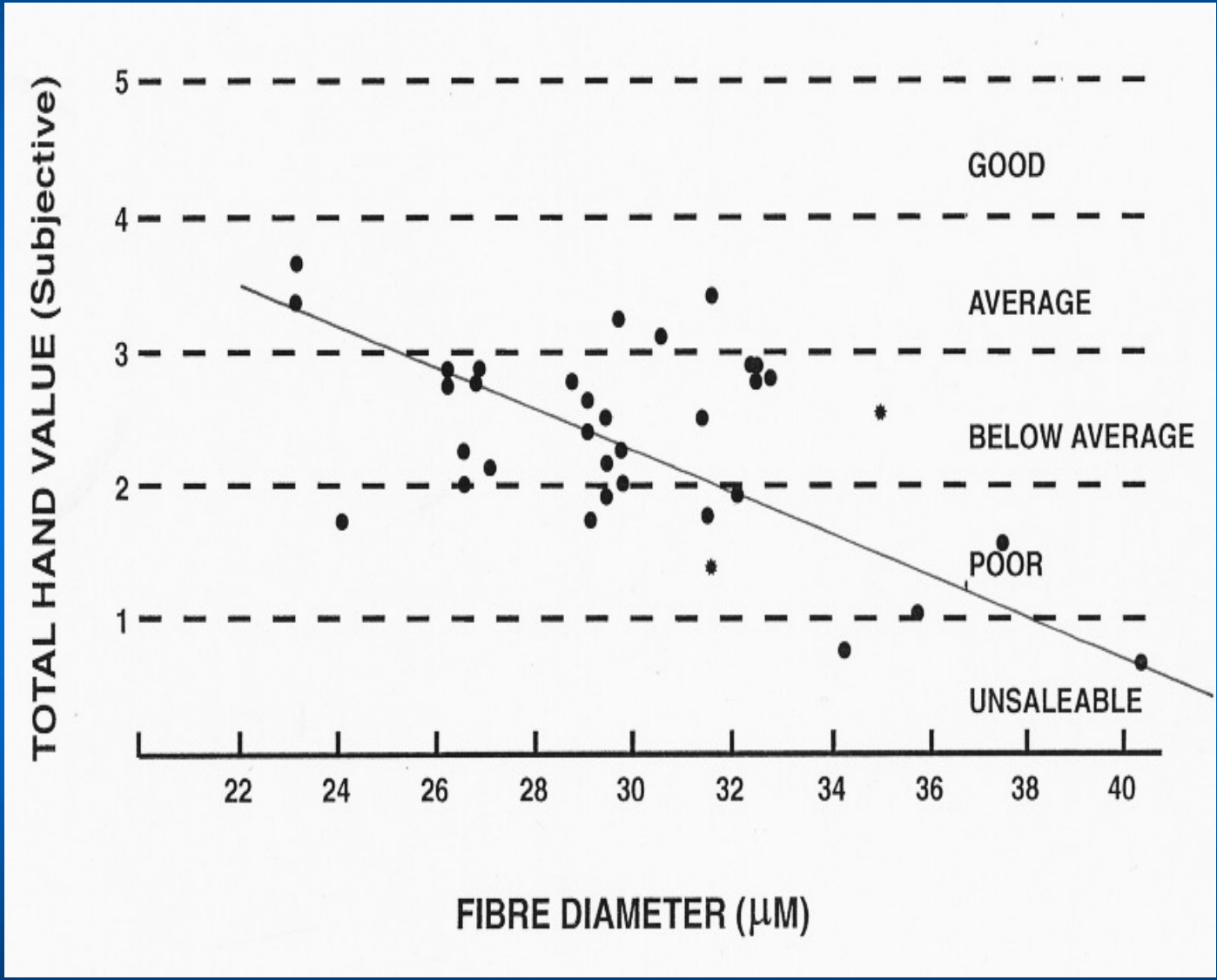
Fabric Handle (subjective): Fibre Diameter



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Source: Postle, R., Kawabata, S., and Niwa, M. (1982)(eds)

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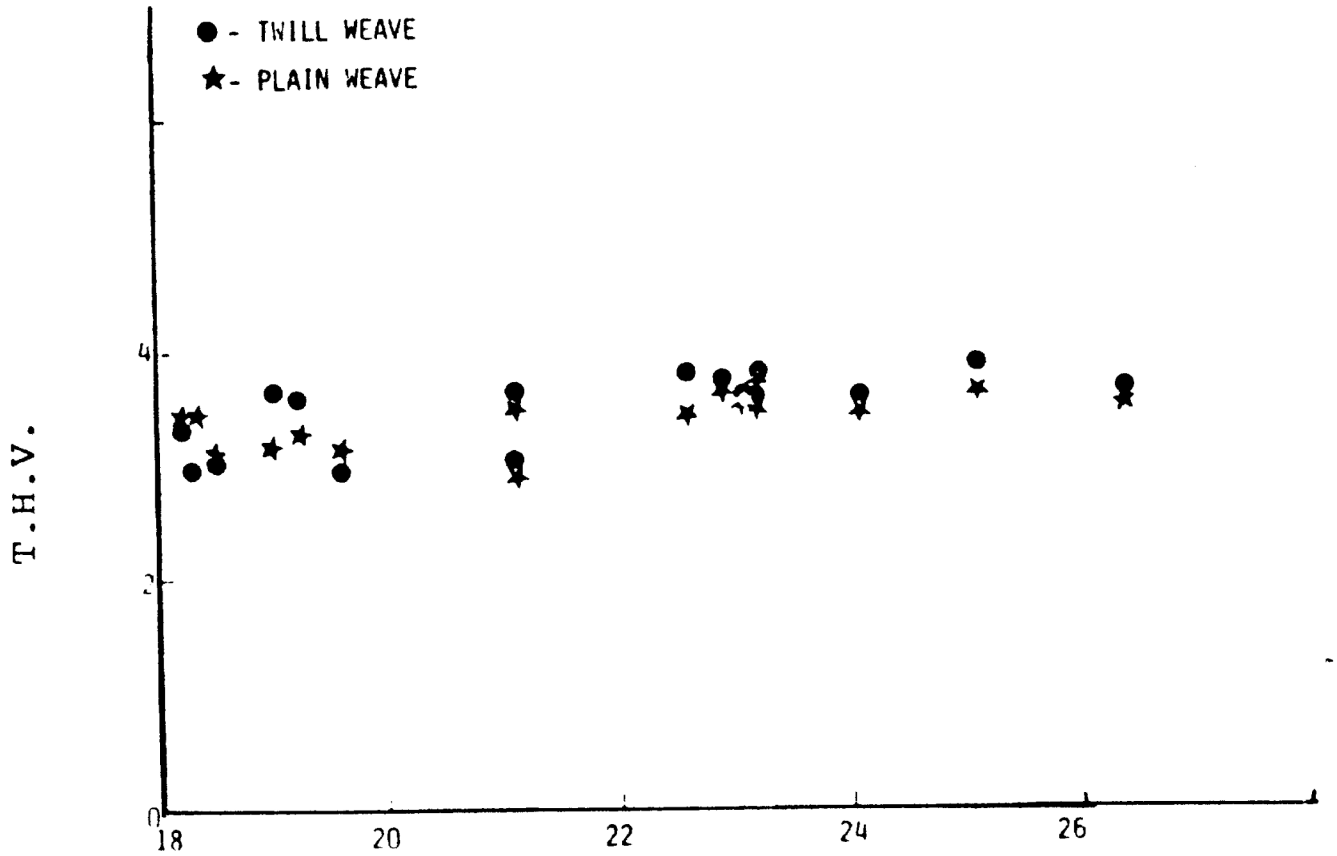
Fabric Handle (objective): Fibre Diameter



Effect of fibre diameter on "Total Hand Value" (THV)

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Source: Postle, R., Kawabata, S., and Niwa, M. (1982) (eds.)

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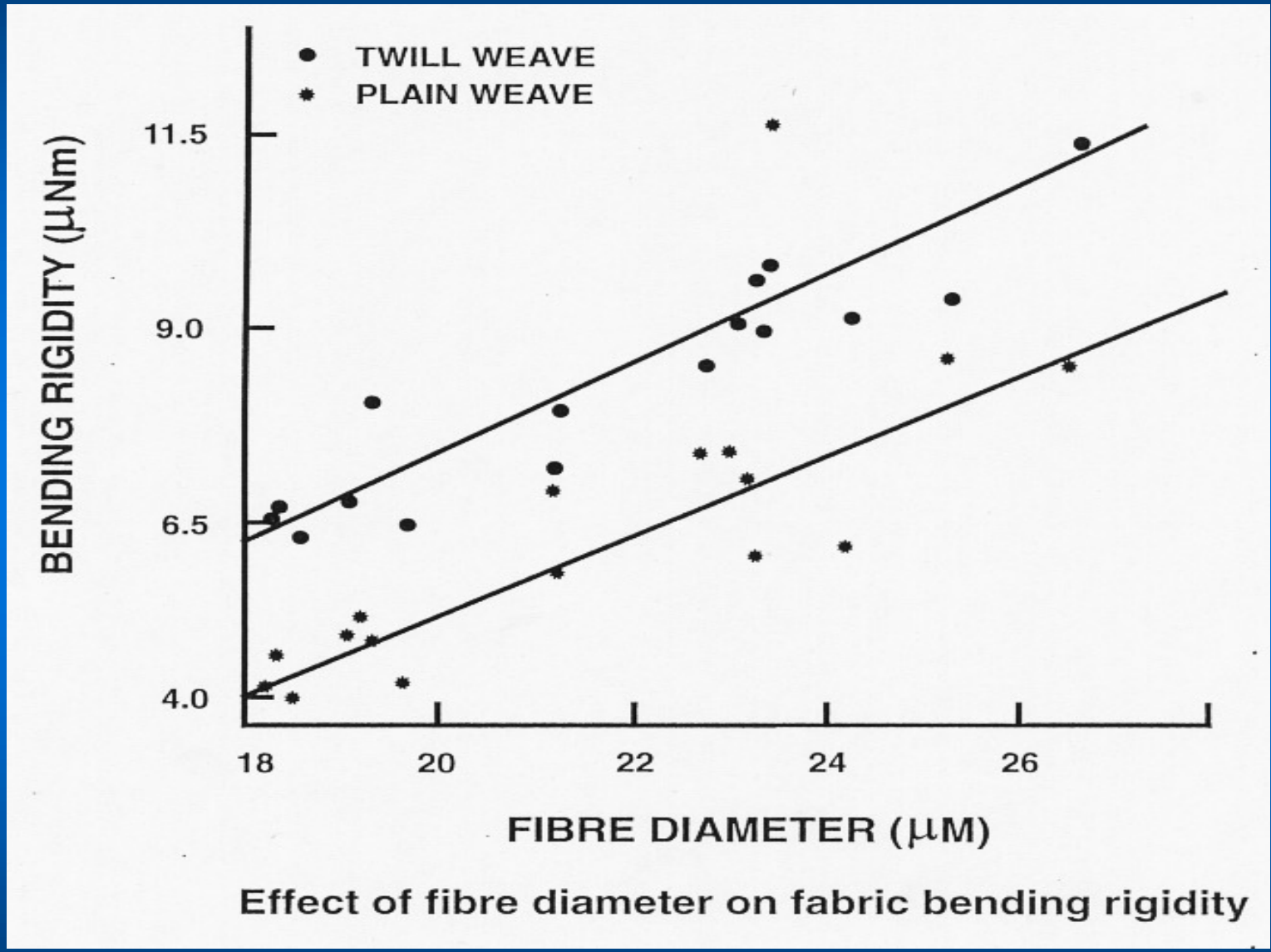
Bending Rigidity: Fibre Diameter



Effect of fibre diameter on fabric bending rigidity

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Source: Postle, R., Kawabata, S., and Niwa, M. (1982) (eds.)

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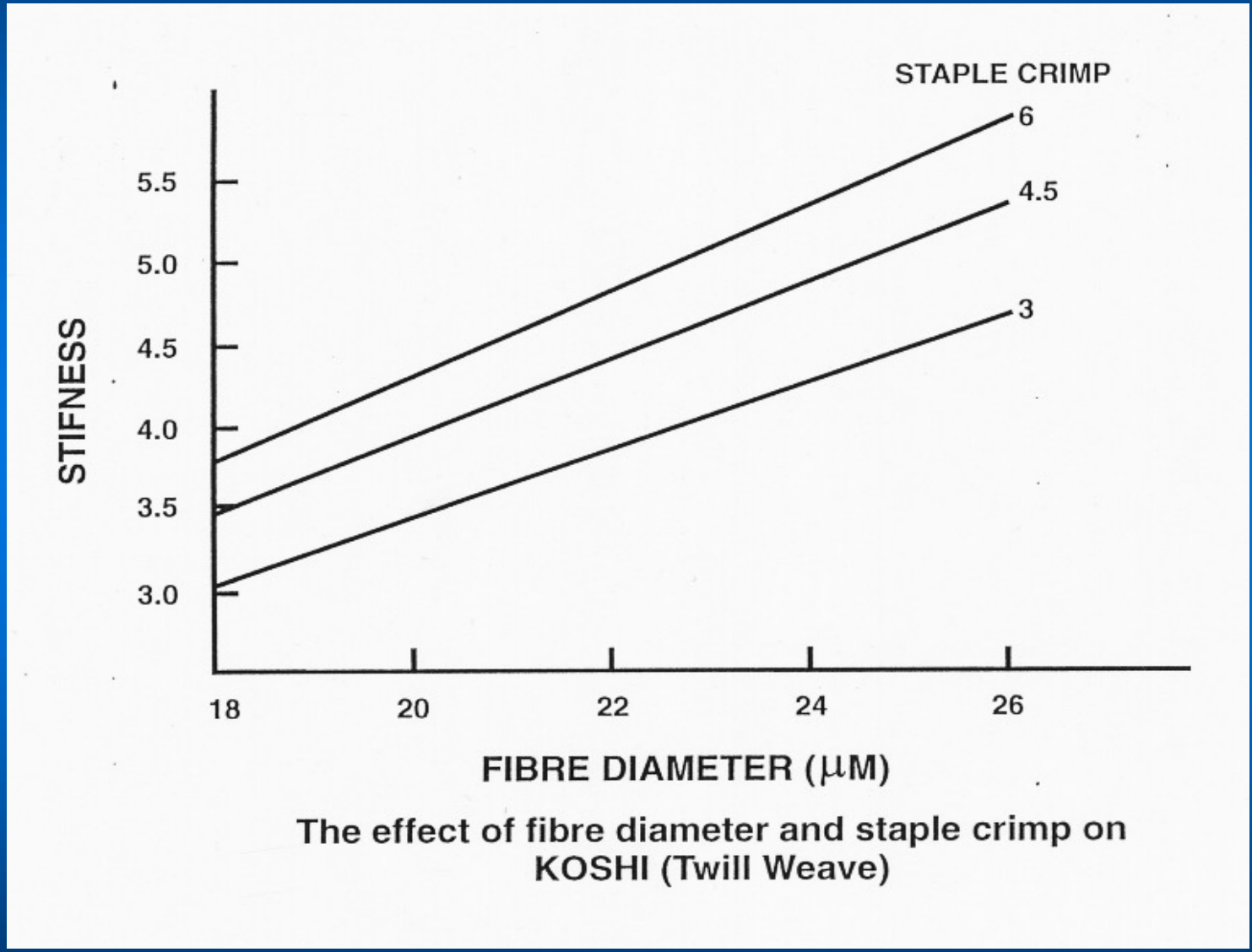
Fabric Stiffness: Fibre Diameter & Crimp



The effect of fibre diameter and staple crimp on KOSHI (Twill Weave)

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Source: Postle, R., Kawabata, S., and Niwa, M. (1982) (eds.)

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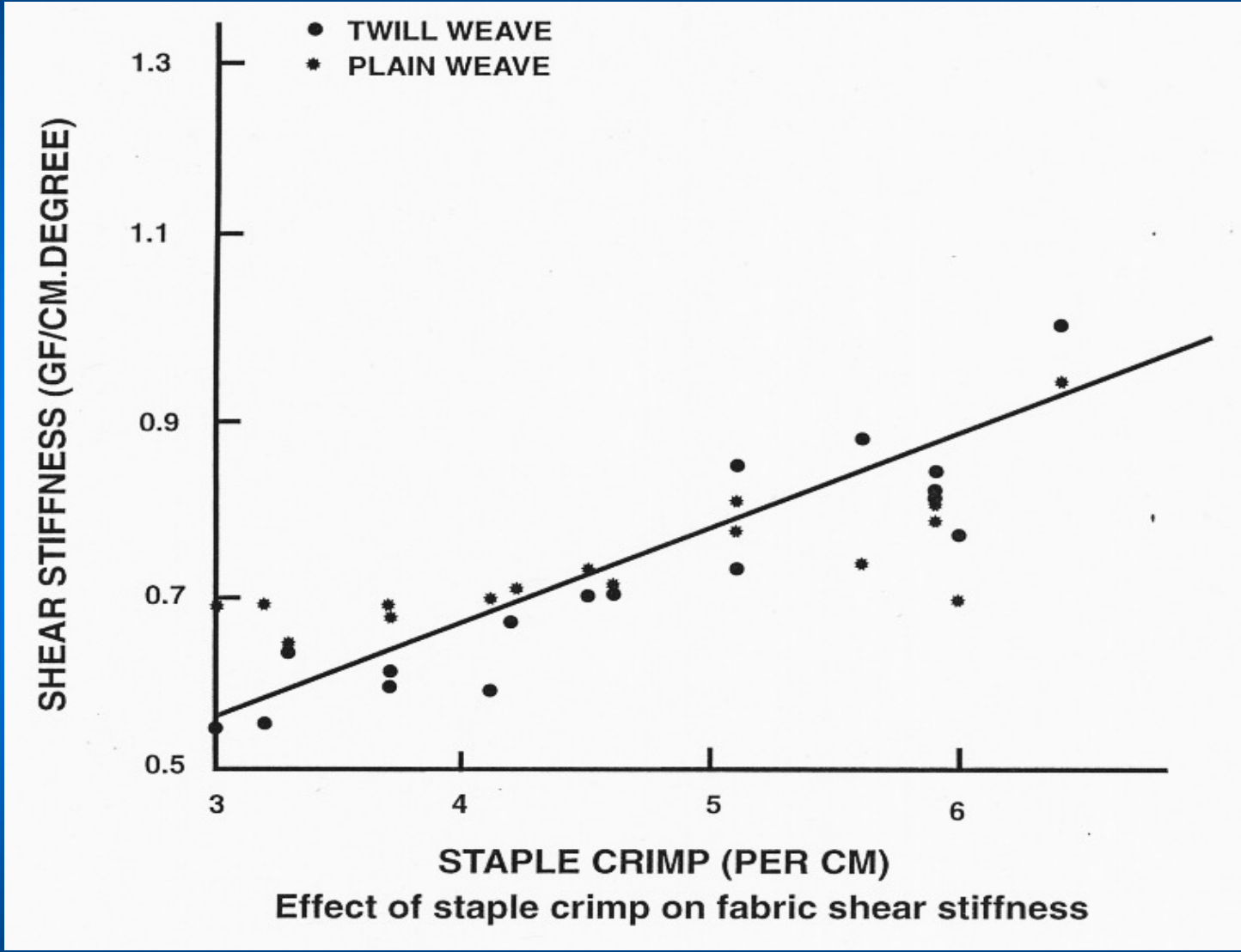
Fabric Handle: Staple Crimp



Effect of staple crimp on fabric shear stiffness

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Source: Postle, R., Kawabata, S., and Niwa, M. (1982) (eds.)

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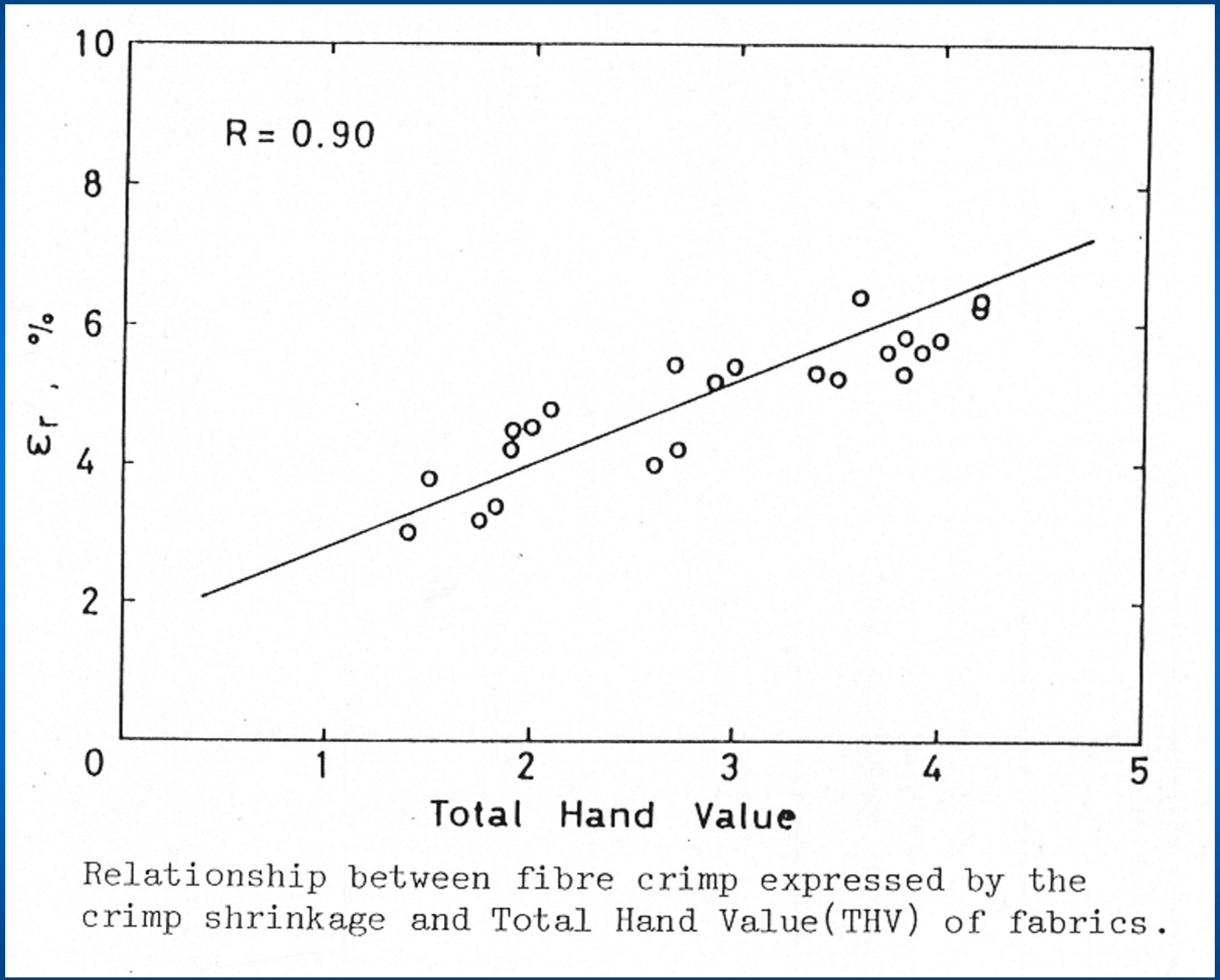
Fabric Handle (objective): Fibre Crimp



Relationship between fibre crimp expressed by the crimp shrinkage and Total Hand Value(THV) of fabrics.

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Source: Postle, R., Kawabata, S., and Niwa, M. (1983) (eds.)

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Fabric Handle: Fibre Diameter

- **Subjective**
  - (increase)
  - less supple (stiffer)
  - less smooth
  - lower preference
    - THV (subjective) lower
    - NZ X-bred wool
- **Objective**
  - (increase)
  - THV (objective) higher
  - bending rigidity increased
  - fabric stiffness increased

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Fabric Handle: Fibre Crimp

- Subjective
  - (increase)
  - rougher fabrics
    - low fibre crimp smoother
- Objective
  - (increase)
  - better quality fabrics
    - THV (objective) higher
    - bulkier yarns
    - more lively yarns
    - more retained crimp
  - stiffer fabrics
  - shear stiffness increased
    - thicker fabrics
    - more resilient

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Appearance in wear

- Hygral expansion (dimensional)
  - reversible
  - change in humidity changes weave crimp
- Crimp
  - (increase)
  - hygral expansion increased
  - weave crimp increased
- Fabric structure and finishing more important

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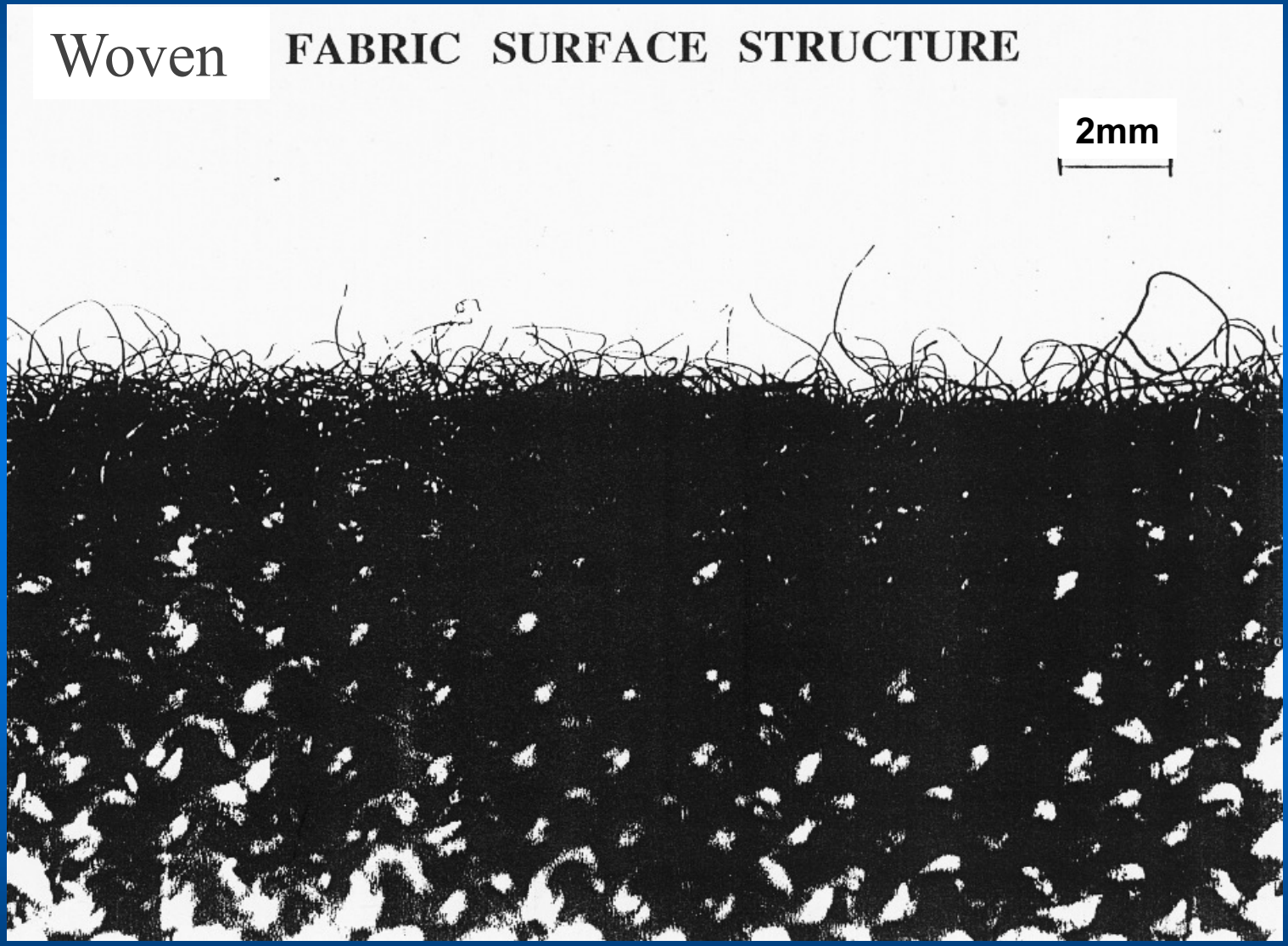
Fabric Comfort (woven)



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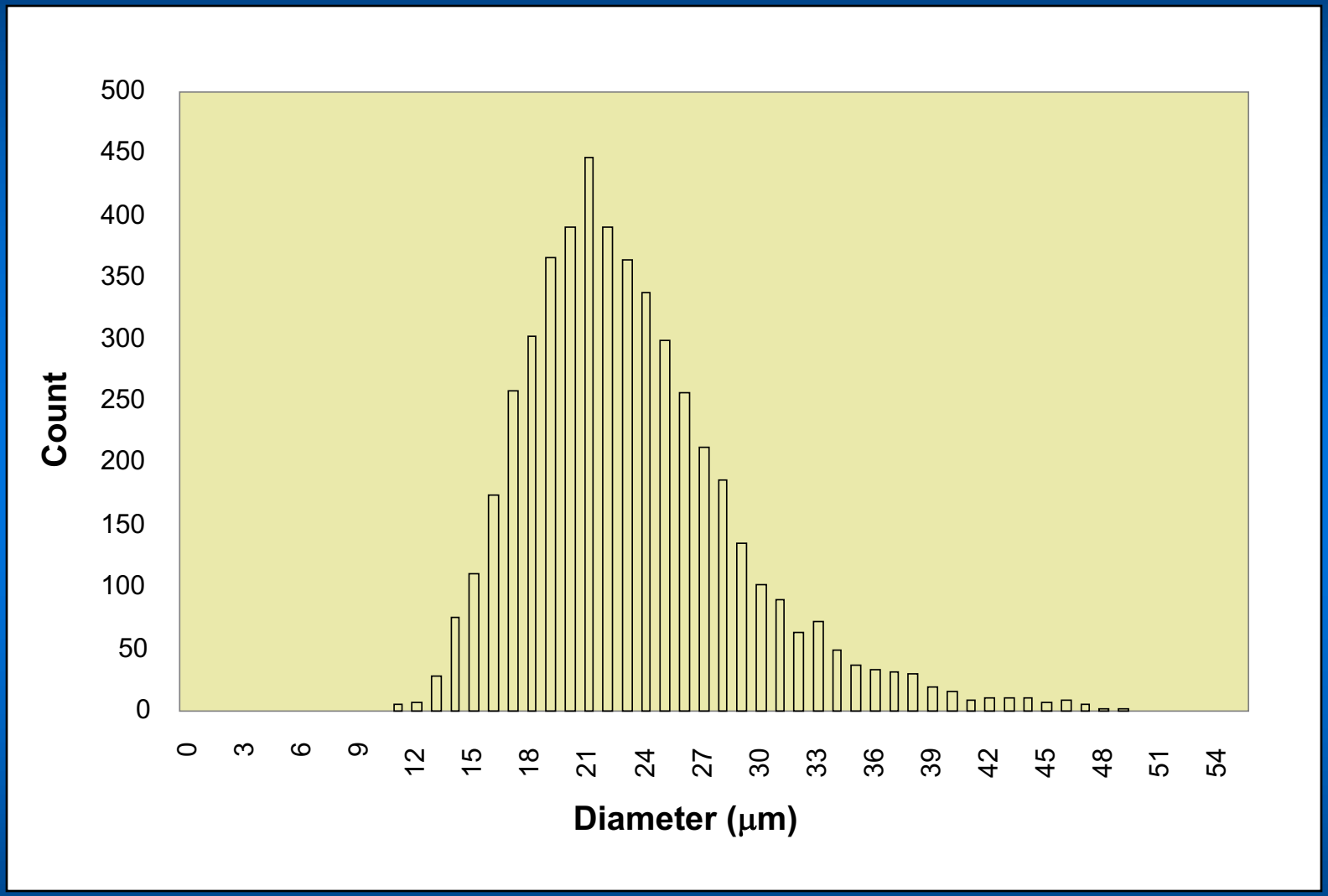
Fibre Diameter Distribution



MFD = 23.4 **CV_D = 25.5**

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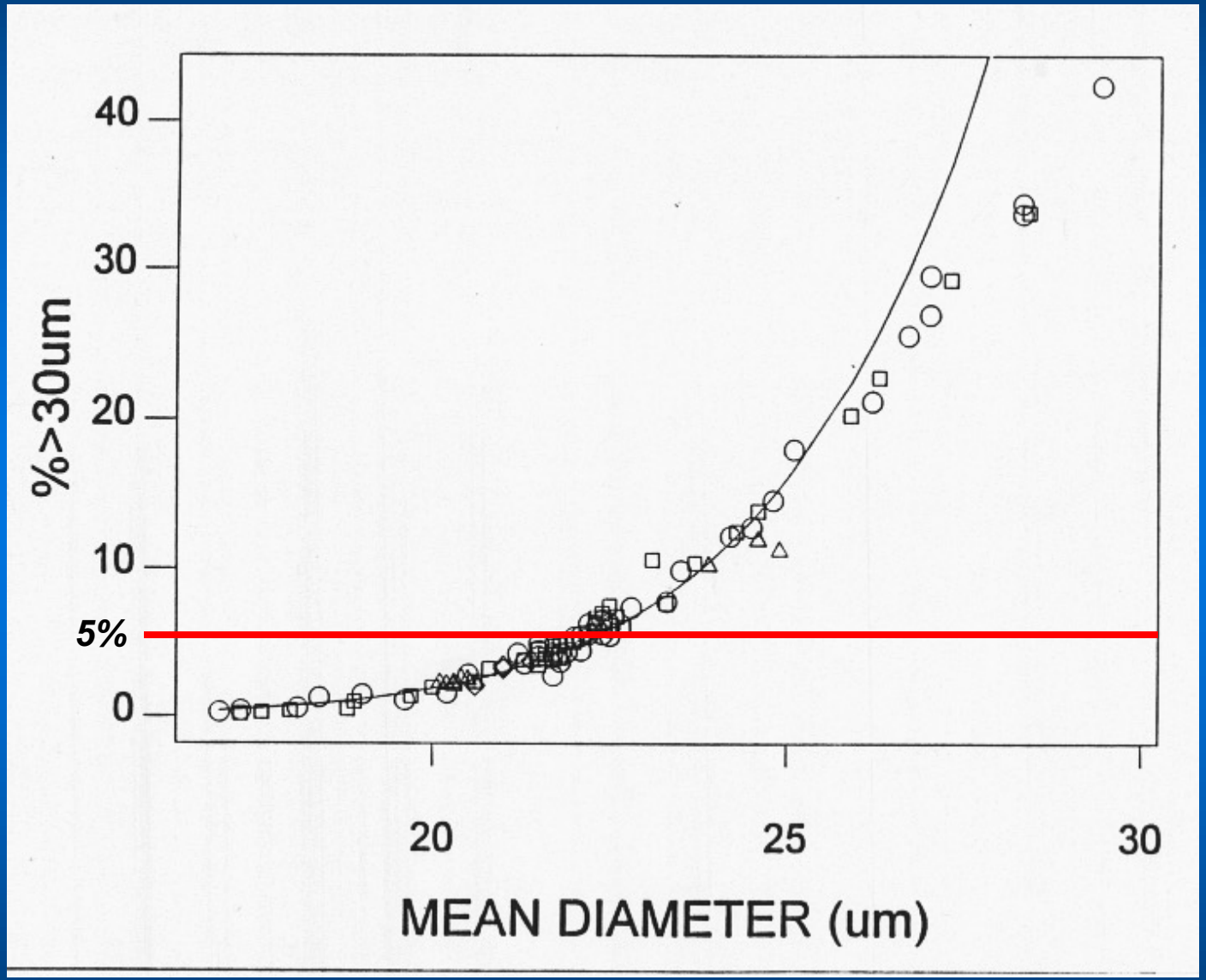
MFD vs. % fibres >30µm



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Contribution to Prickle

		relative effect
• Fibre diameter	(1μm)	10
• CV of diameter	(1%)	3
• Fibre length	(5mm)	-2
• Yarn Count	(60-100 tex)	0
• Cover factor	(0.15units)	4
• Finishing	(raising)	-10

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Source: Naylor, G.R. & Phillips, D.G., (1995)

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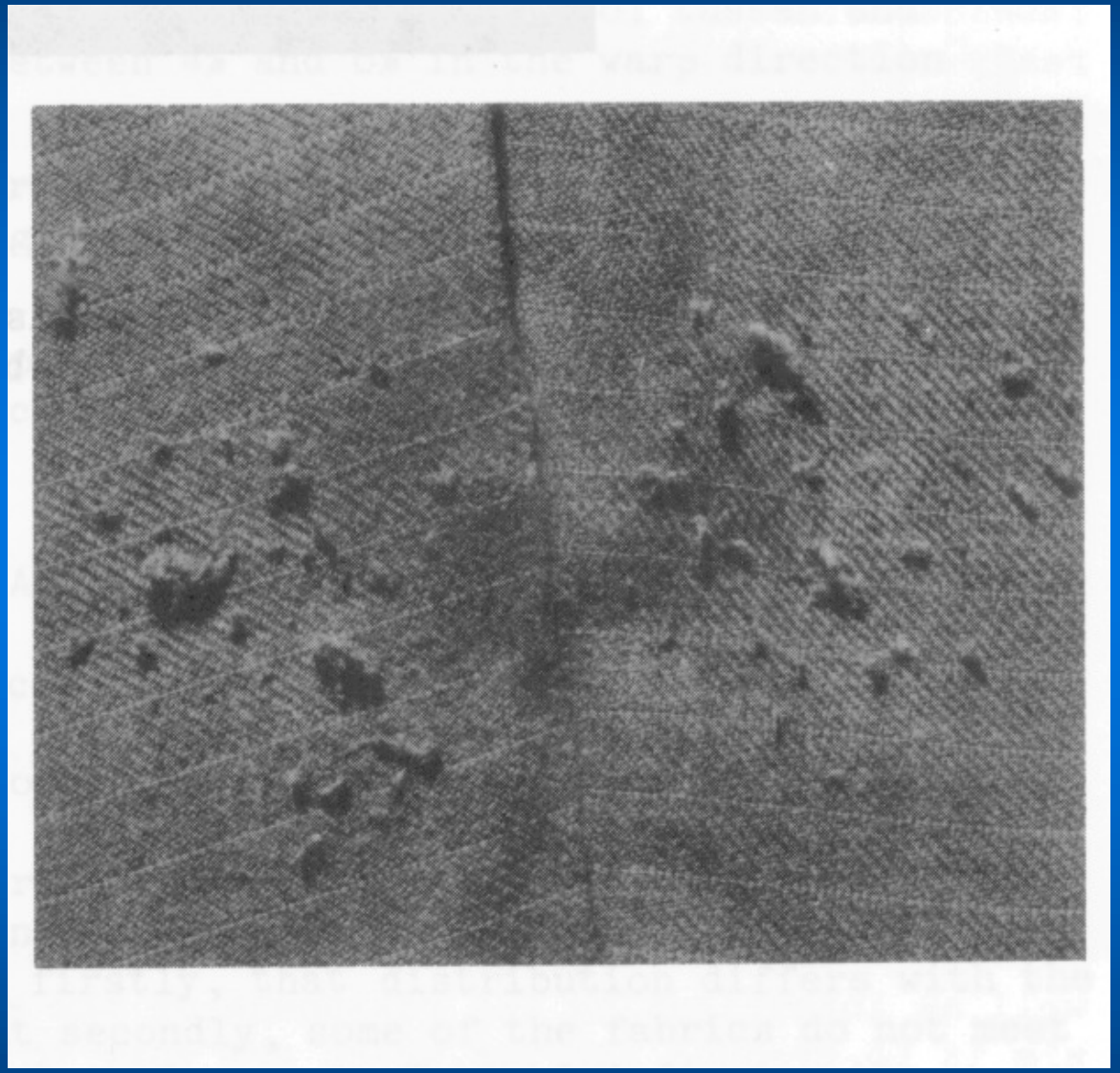
Pilling



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Source: Postle, R., Kawabata, S., and Niwa, M. (1983) (eds.)

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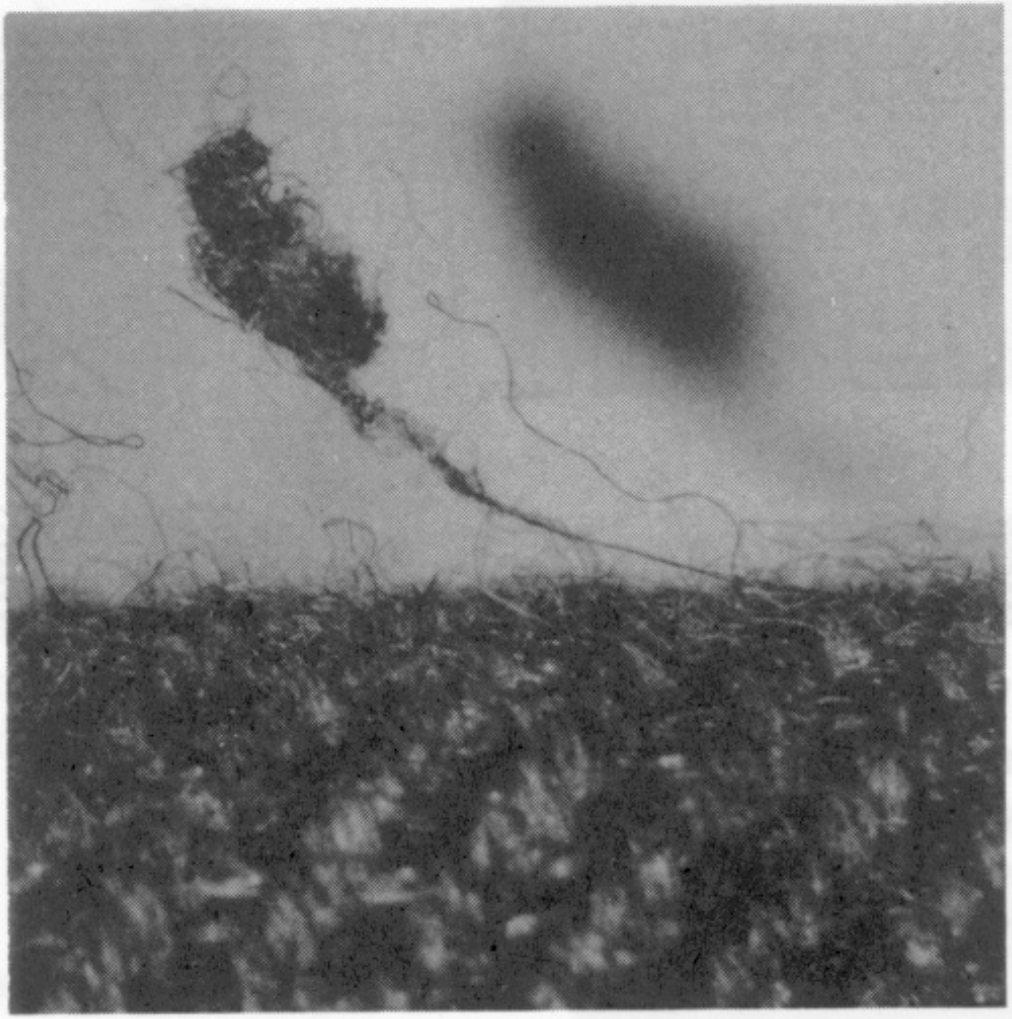
Pilling



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Source: Postle, R., Kawabata, S., and Niwa, M. (1983) (eds.)

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Pilling: Diameter & Length

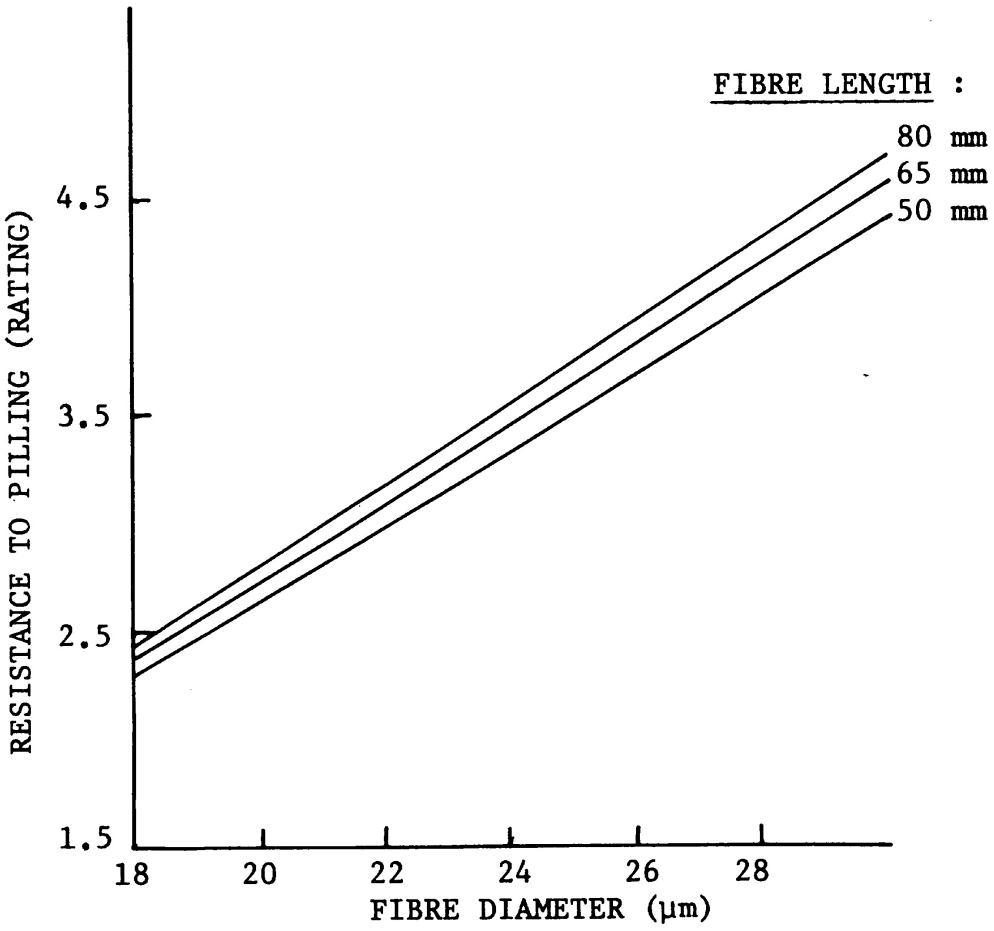

Fig. 4 Regression curves illustrating the effects of fibre diameter and fibre length on fabric resistance to pilling (Punto-di-roma).

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Source: Postle, R., Kawabata, S., and Niwa, M. (1983) (eds.)

Contribution to Pilling (knitwear)

	relative effect
• Fibre diameter	5
• Yarn twist	5
• Stitch length	10
• Finishing (degradative)	10

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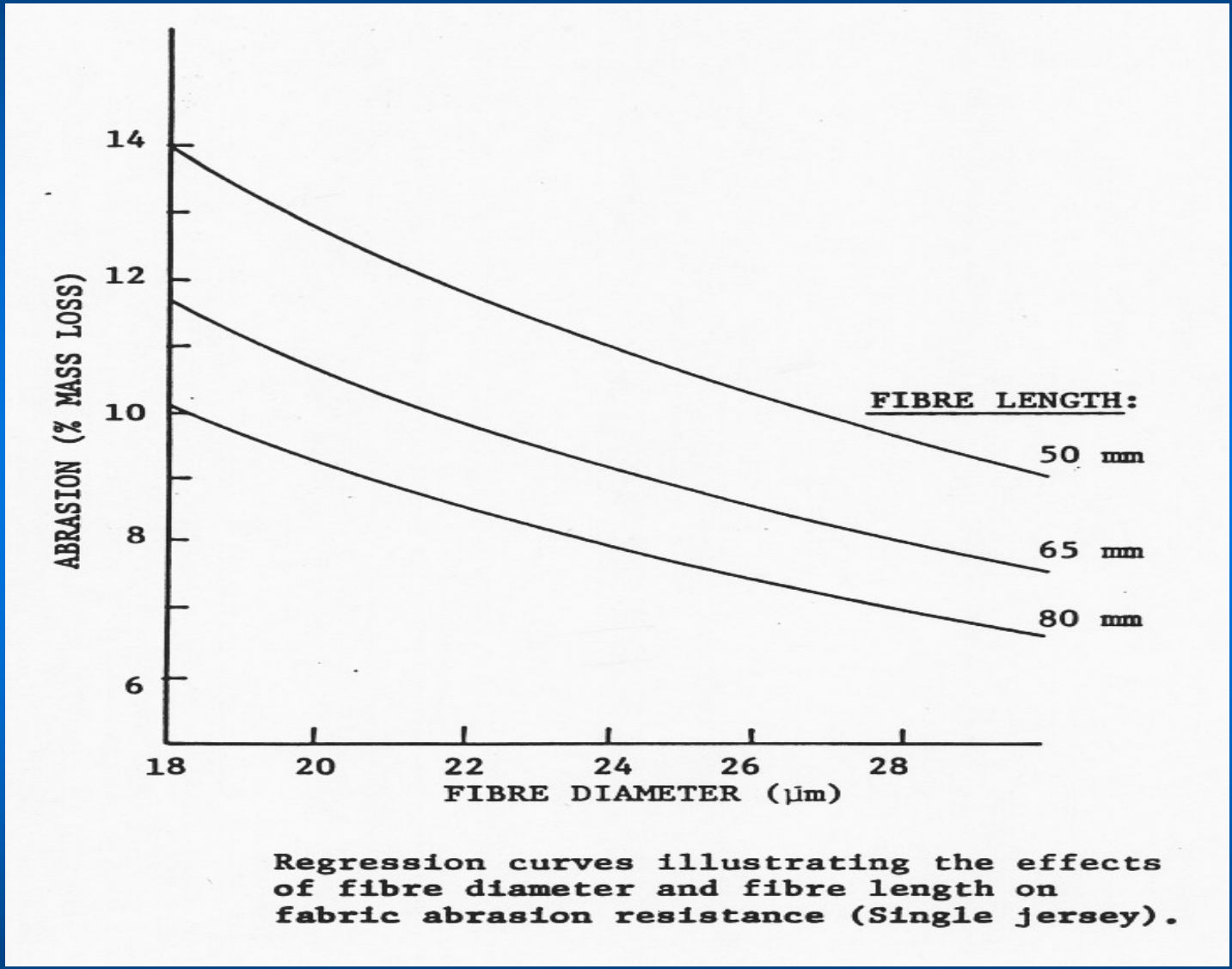
Abrasion: Fibre Diameter & Length



Regression curves illustrating the effects of fibre diameter and fibre length on fabric abrasion resistance (Single jersey).

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Source: Postle, R., Kawabata, S., and Niwa, M. (1983) (eds.)

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Contribution of Finishing

Finish	Effective micron shift
• Pressure decatise	- 5
• Chemical Set	- 2.5
• Wet decatise	- 1
• Piece dyeing	- 4.5
• Polymer shrink resist	+ 4

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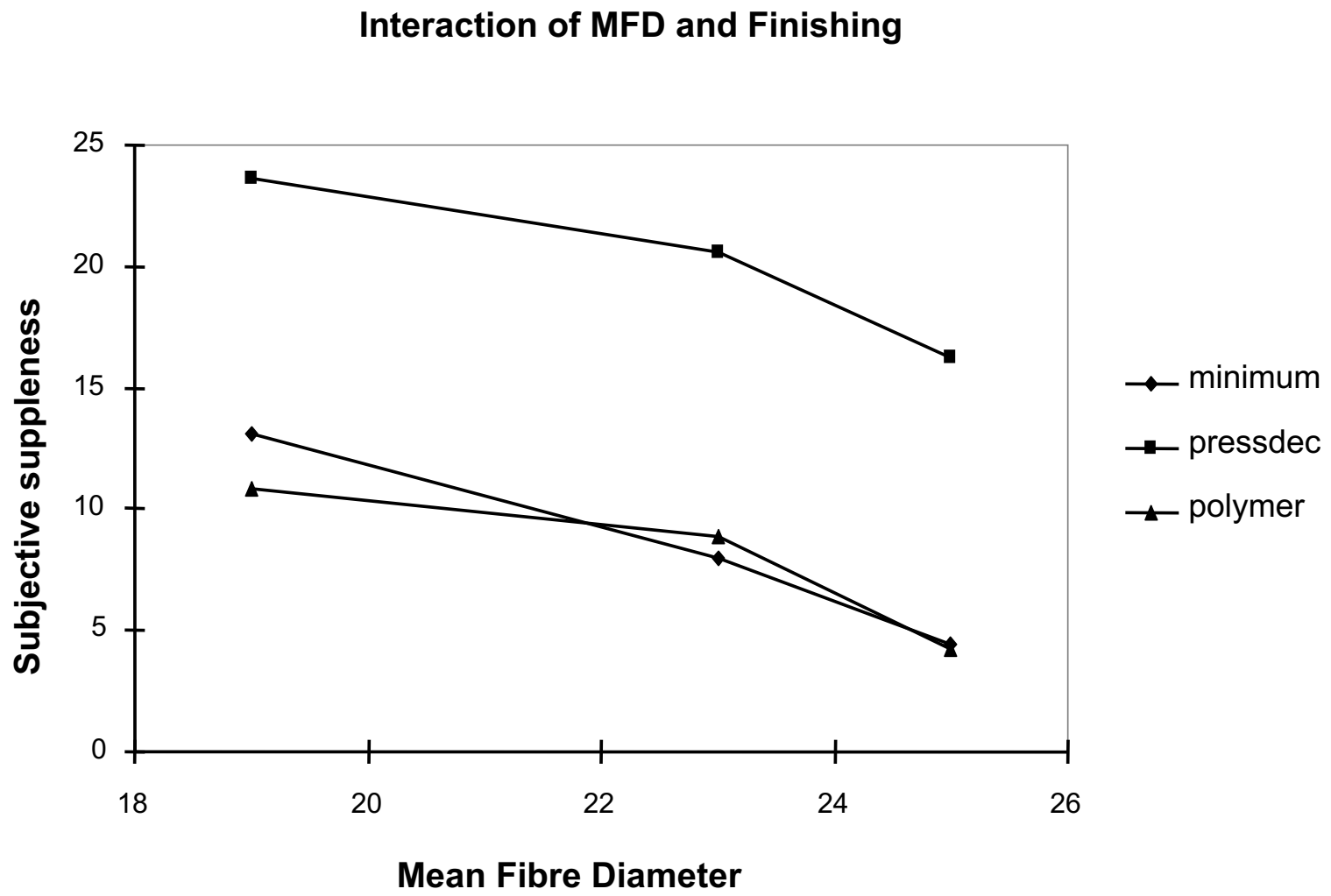
Source: de Boos, A. & Kenin, P (unpubl.)

Finishing Effects



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Wrinkle Recovery

- Ability of fabric to recover from deformation (creasing) in wear
- Depends on
  - fibre stress relaxation
  - proximity of T_g to usage temps
    - moisture lowers T_g

Contribution of fibre properties is small

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Ease of Garment Manufacture

- Depends on
  - mechanical properties
  - dimensional properties
  - pressing performance
  - fibre-needle friction

Little information on role of fibre properties in some areas

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Summary

	Aesthetic	Functional
• Diameter	10	3
• CV_D	3	1
• Coarse Edge	10	1
• Crimp	4	3
• Style	4	2
• Fibre Strength		8
• Colour	5	
• Contaminants	3	

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Further Reading

- Postle, R., Kawabata, S., and Niwa, M. (1982) (eds.), Objective Evaluation of Fabric Quality, Mechanical Properties and Performance, The Textile Machinery Society of Japan

- Postle, R., Kawabata, S., and Niwa, M. (1983) (eds.), Objective Evaluation of Apparel Fabrics, The Textile Machinery Society of Japan

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