

**“ACE”**  
*Team*

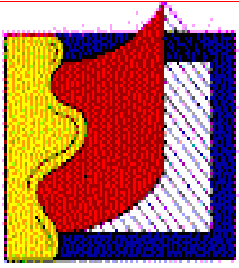
# **HUNTSMAN**

# **Polyurethanes**

**Samantha Smith**

**Jay A. Johnston**

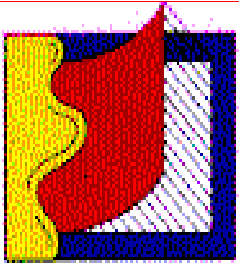
**Auburn Hills Michigan**



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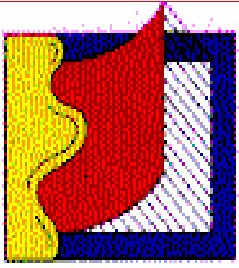
# **The Softer Side of Polyurea Elastomer Coatings**



## Advantages of Spray Polyurea

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- A wide range of physical properties is possible  
(i.e. 4000 psi / 260% / 590 pli / Shore D 65  
3500 psi / 500% / 500 pli / Shore D 48 to  
1200 psi / 800% / 200 pli / Shore D 15)
- Fast gel and tackfree times (typically 2-25 seconds)
- Can walk on coating in 10 minutes
- 100 % solids formulation possible
- Thick film build
- Spray applied in the field
- Applicable at low temperatures
- High productivity per employee (1gallon/min.)
- New prepolymers have lower viscosities
- Lower processing pressures are possible
- No catalyst required
- Insensitivity to atmospheric and substrate moisture
- Catalyst are not present to promote high temperature decomposition
- New primers are available for spray polyurea

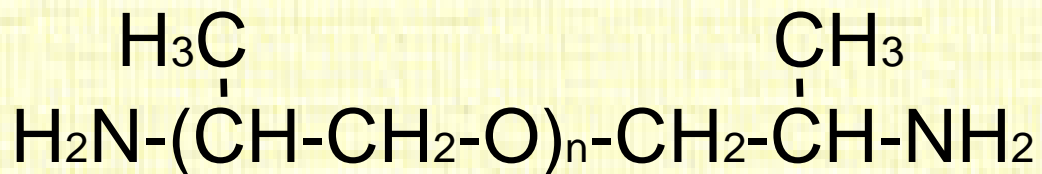


# Amine-Isocyanate Reaction

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OCN-PREPOLYMER-NCO

+



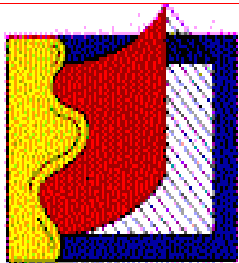
+

Primary or Secondary Chain Extenders



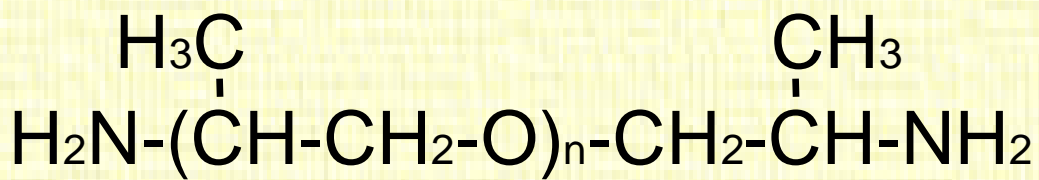
Optional Additives

POLYUREA

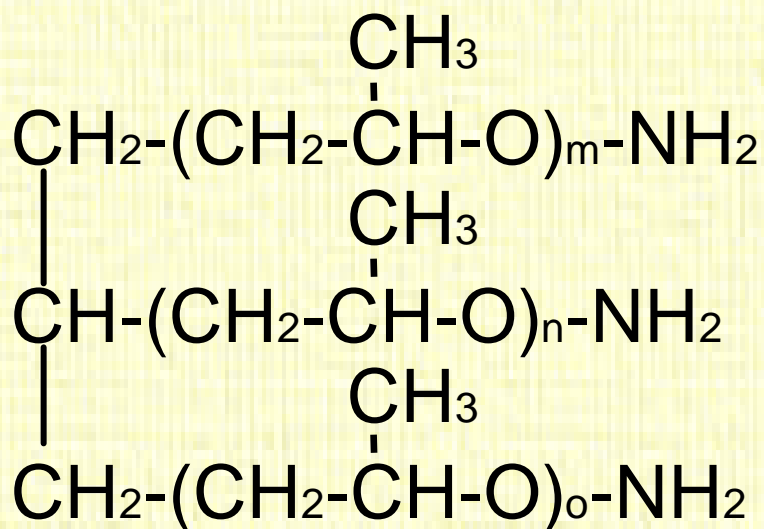


# Amine Terminated Polyether

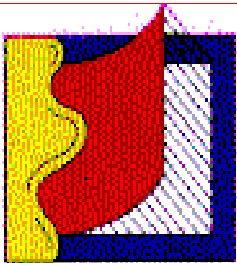
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JEFFAMINE ® D-2000 amine

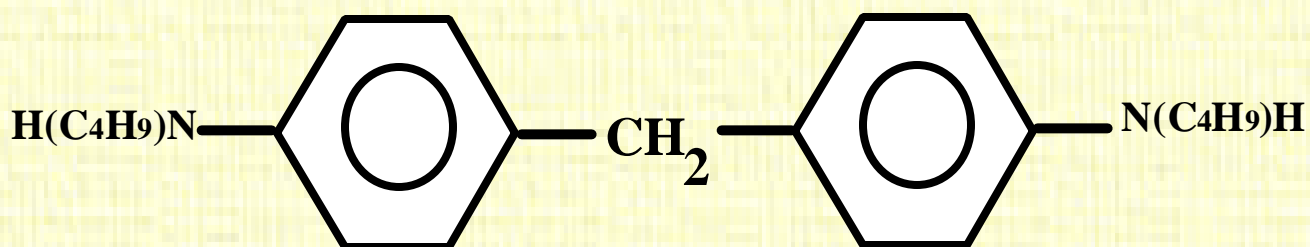


JEFFAMINE T-5000 Amine

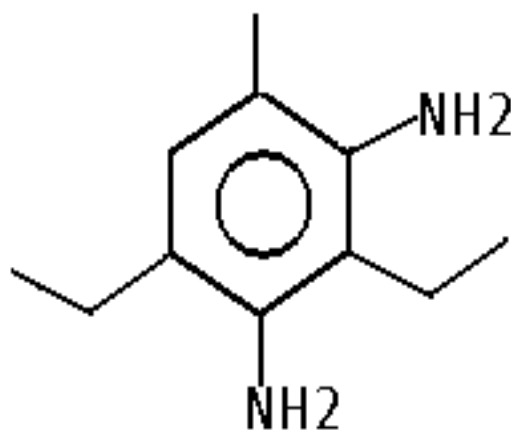


# Amine Chain Extenders

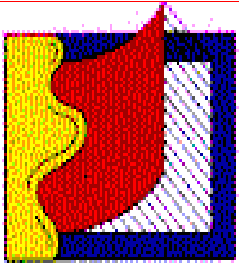
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UNILINK® 4200 chain extender

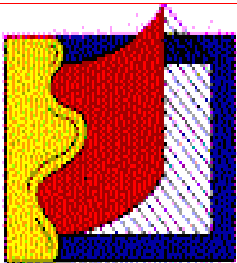


DETDA (+isomers)



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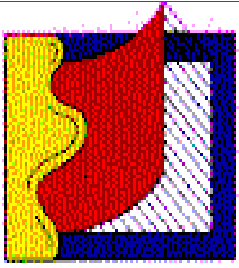
# **Standard Physical Properties of Aromatic Polyurea Elastomer Coatings**



# Spray Polyurea Prepolymers

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Prepolymer	NCO (%)	Viscosity (cps)
RUBINATE® 9009 MDI	15.6	1300
RUBINATE 9495 MDI	15.2	366
RUBINATE 9480 MDI	15.2	355
RUBINATE 9484 MDI	16.0	253
RUBINATE 9483 MDI	15.5	350



## B-side Formulation

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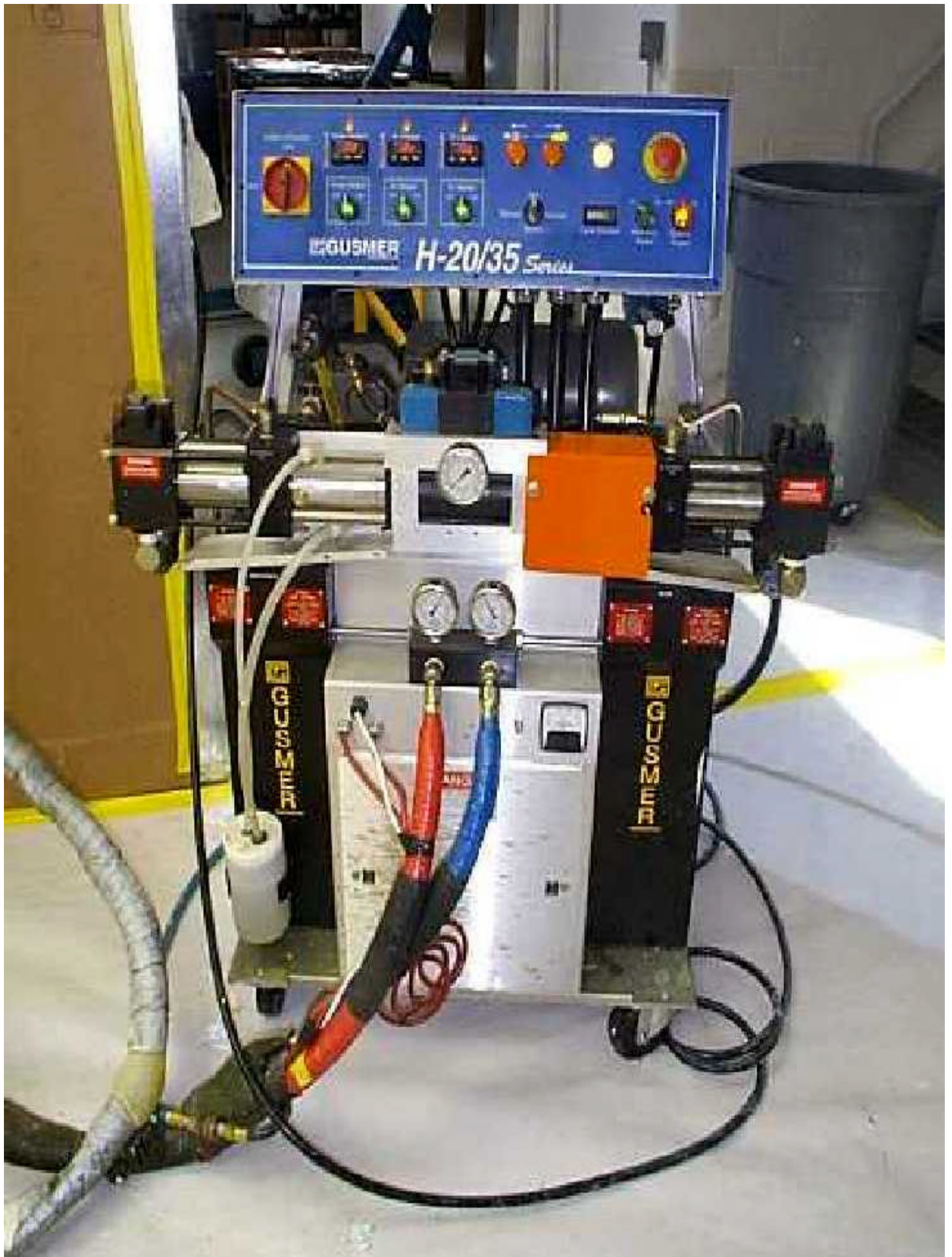
Team

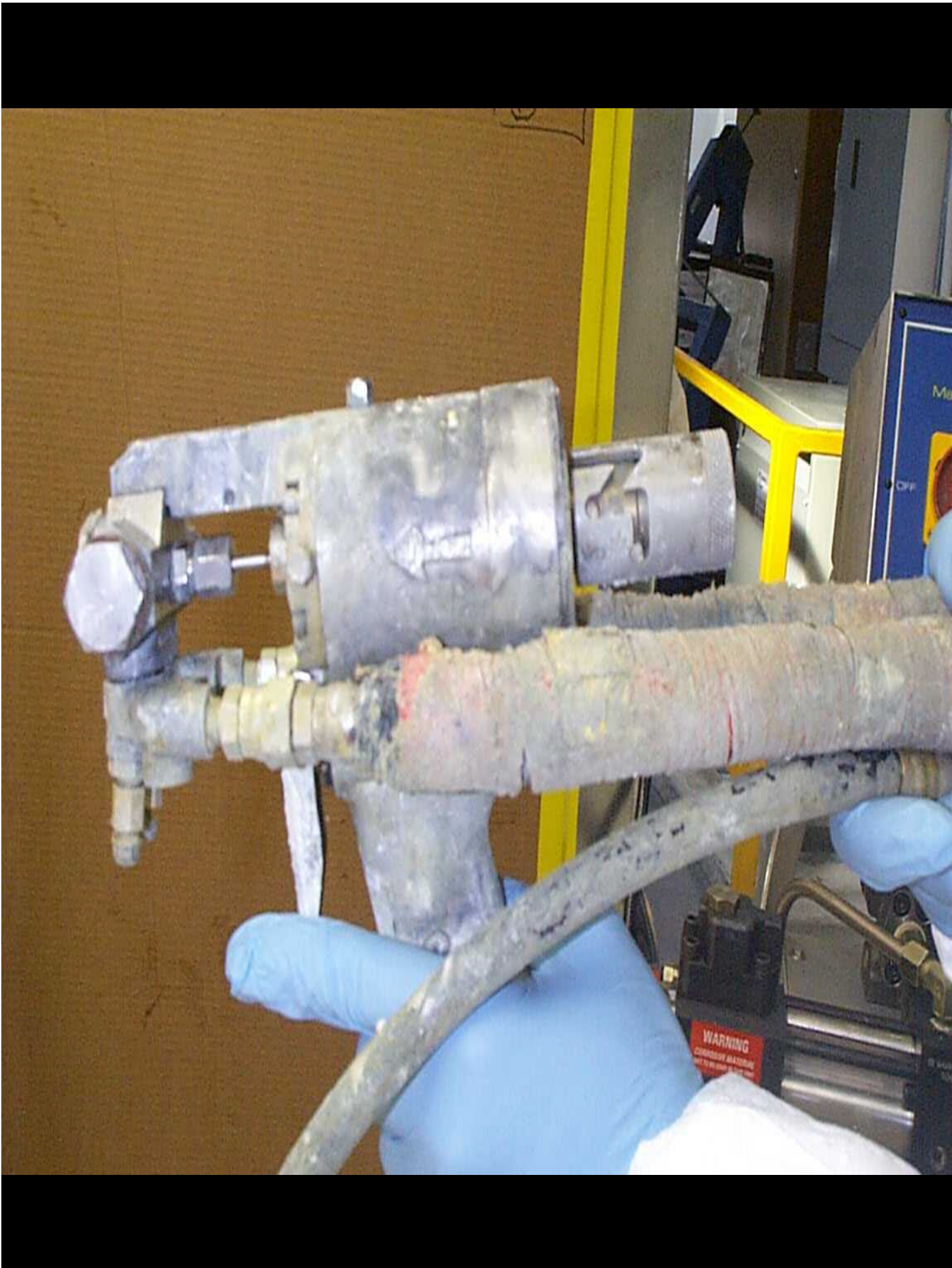
<b>Component</b>	<b>Weight (%)</b>
<b>JEFFAMINE D-2000 amine</b>	<b>54.8</b>
<b>JEFFAMINE T-5000 amine</b>	<b>9.6</b>
<b>ETHACURE® 100 amine</b>	<b>25.4</b>
<b>TiO<sub>2</sub></b>	<b>10.2</b>
<b>Silane A-187</b>	<b>0.9</b>

Processing Parameters

Temperature 71C

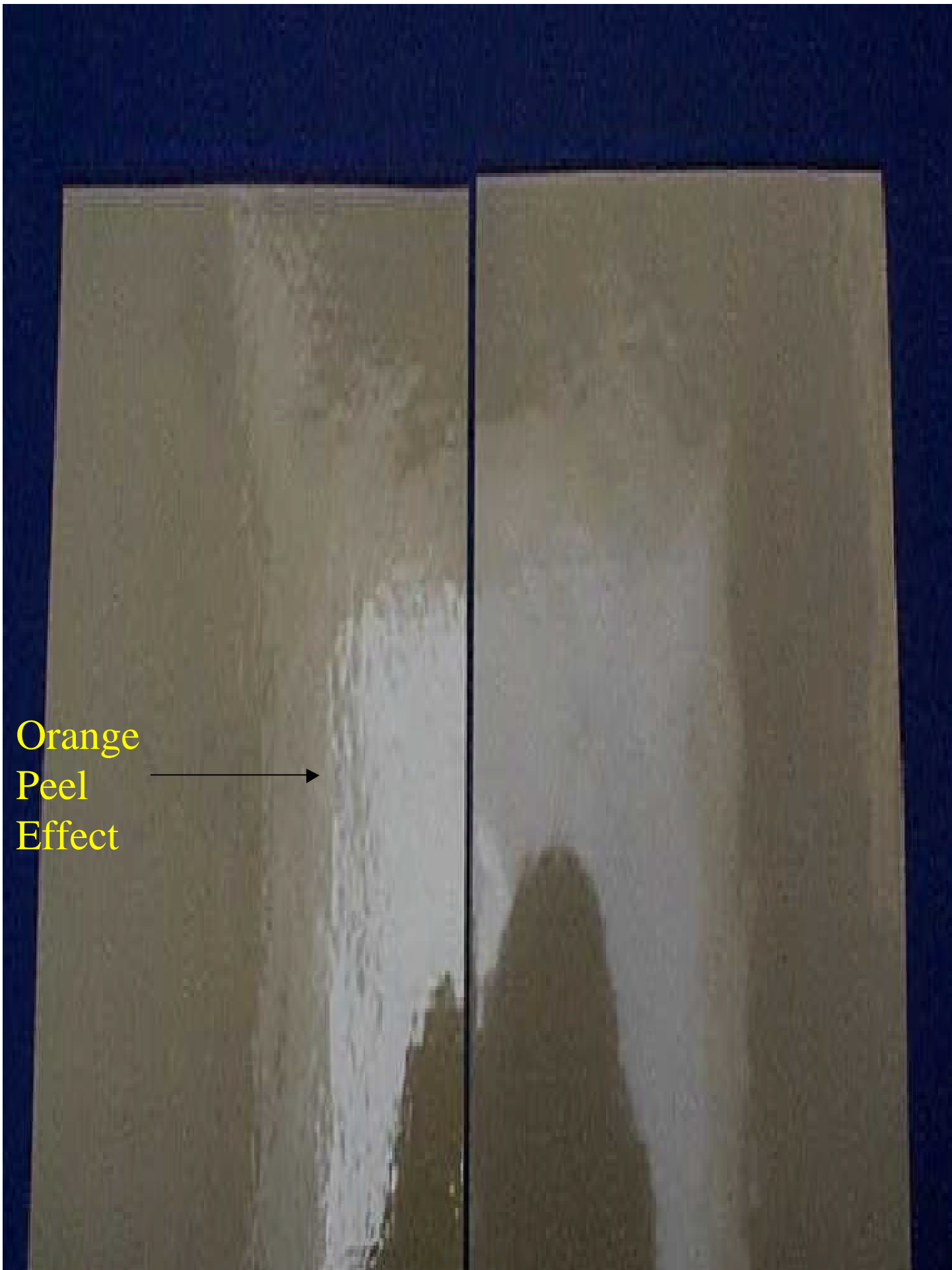
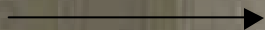
Pressure 2000 psi

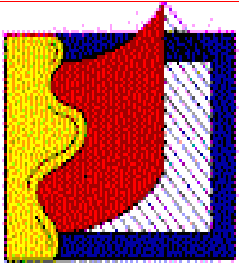






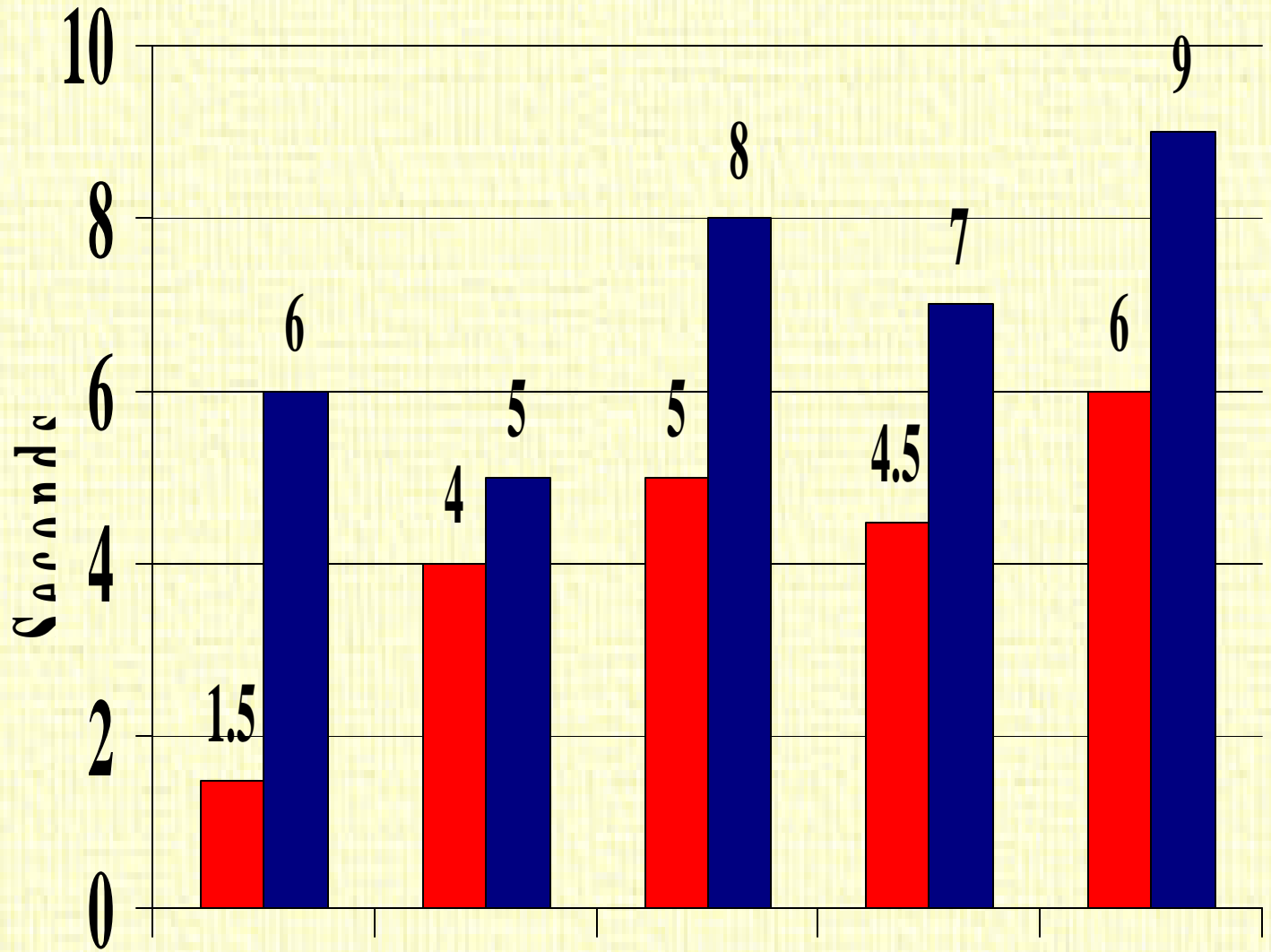
Orange  
Peel  
Effect





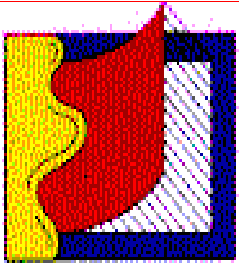
# Reactivity of Spray Polyurea Prepolymers

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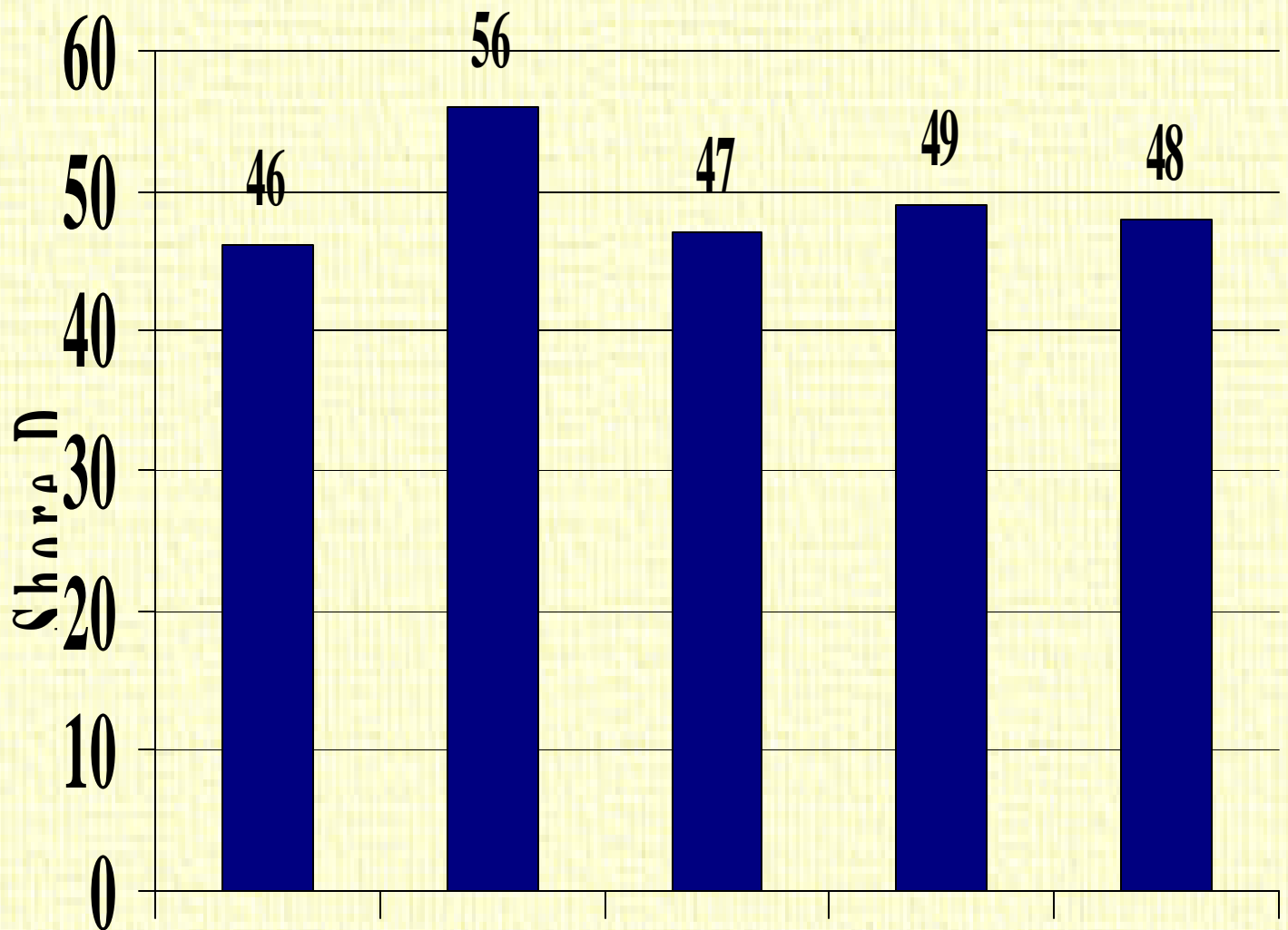
RUBINATE RUBINATE RUBINATE RUBINATE RUBINATE  
9009 MDI 9495 MDI 9480 MDI 9484 MDI 9483 MDI

■ Gel ■ Tackfree



# Hardness of Spray Polyurea Coatings

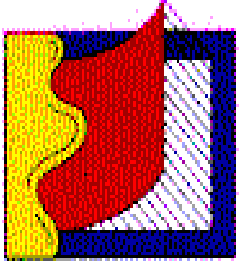
**“ACE”**  
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RUBINATE RUBINATE RUBINATE RUBINATE RUBINATE  
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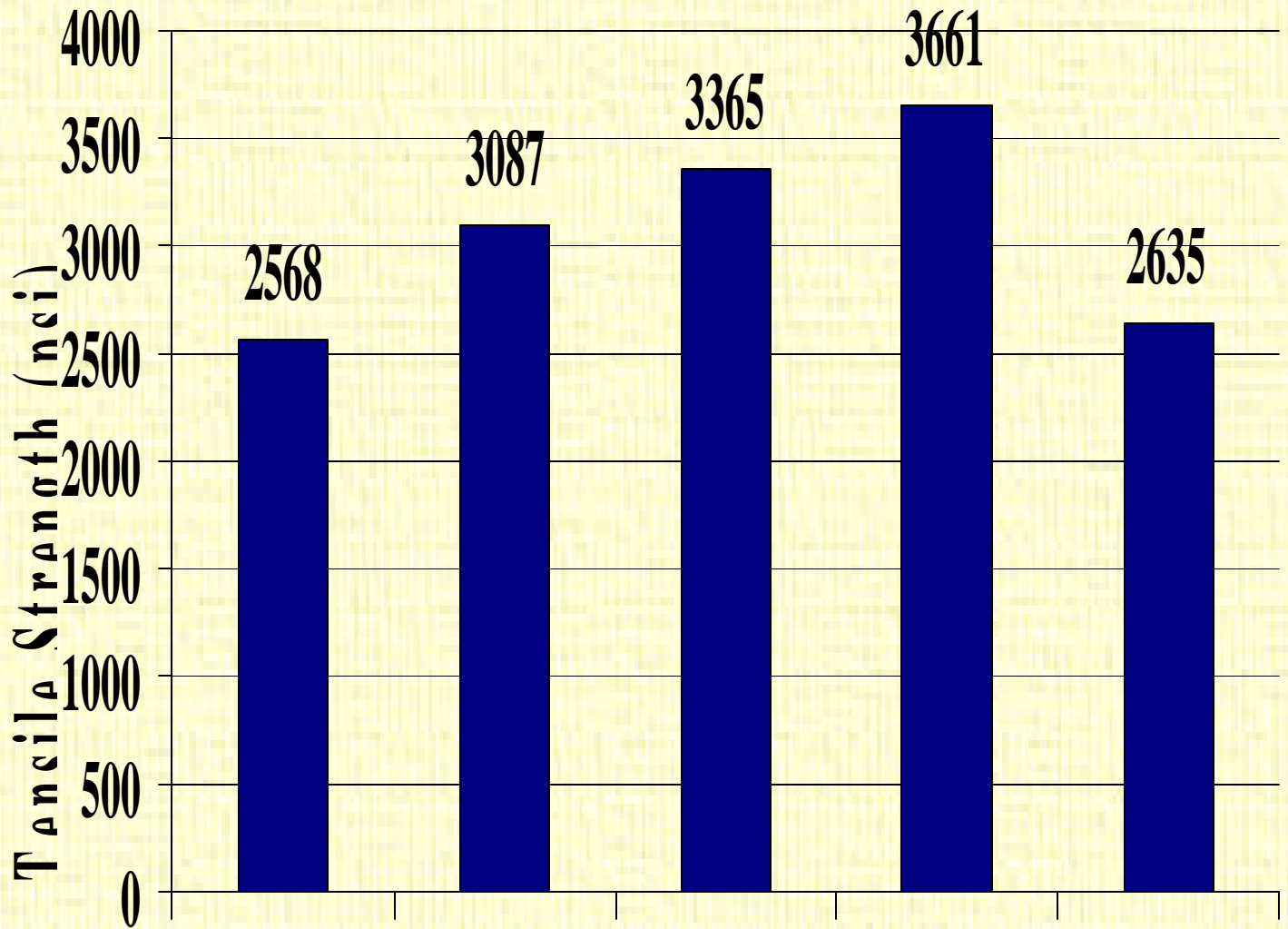
■ Shore D

ASTM D-2240-95



# Tensile Strength of Spray Polyurea Coatings

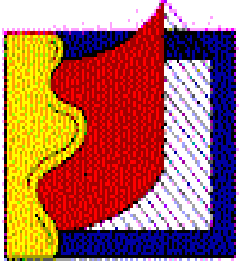
**“ACE”  
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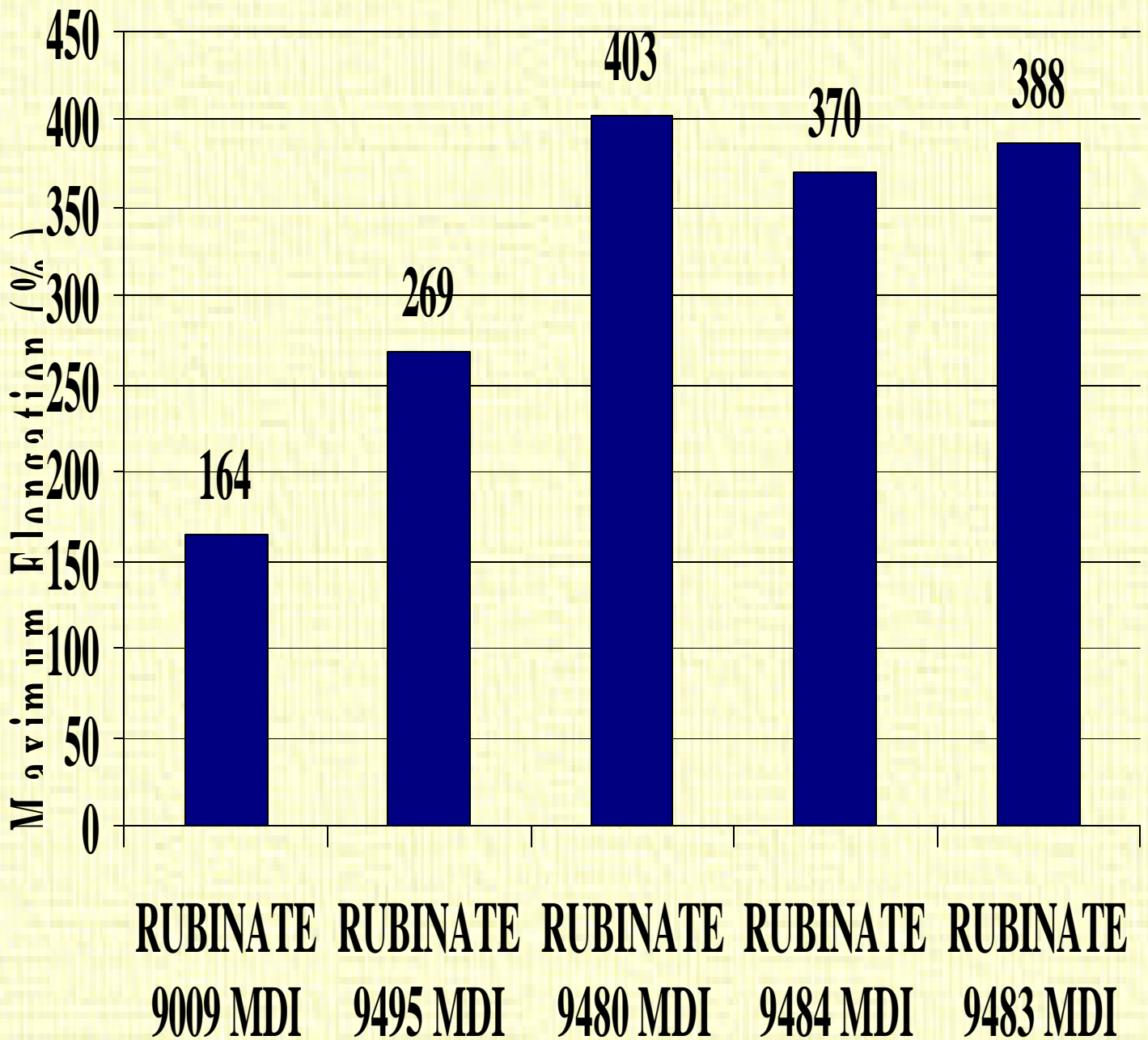
**ASTM D412-92**

**Tensile Strength**



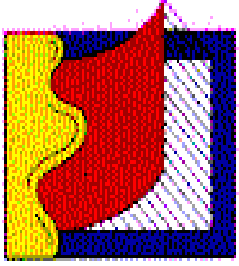
# Maximum Elongation of Spray Polyurea Coatings

**“ACE”  
Team**



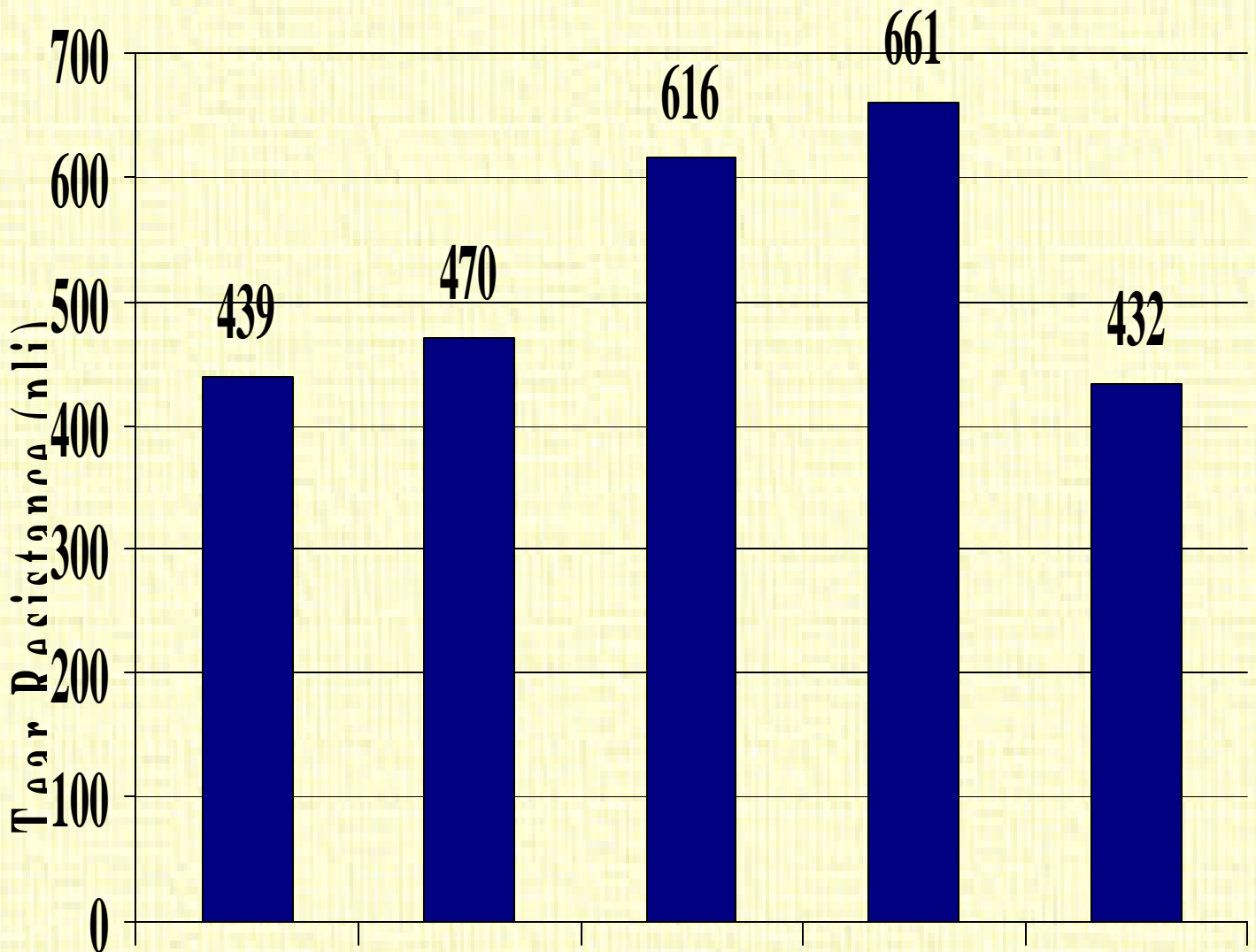
**ASTM D412-92**

**■ Elongation**



# Tear Resistance of Spray Polyurea Coatings

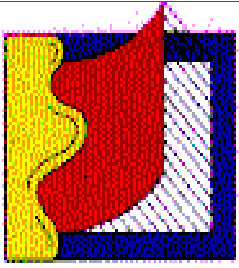
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RUBINATE RUBINATE RUBINATE RUBINATE RUBINATE  
9009 MDI 9495 MDI 9480 MDI 9484 MDI 9483 MDI

**ASTM D624-91**

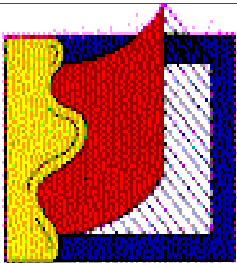
**■ Tear Resistance**



# Spray Polyurea Prepolymers

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Prepolymer	NCO (%)	Viscosity (cps)
RUBINATE 9272 MDI	8.5	2500
SUPRASEC® 9524 MDI	10	2000
RUBINATE 9447 MDI	12.3	1200
RUBINATE 9483 MDI	15.5	350
RUBINATE 9480 MDI	15.2	355

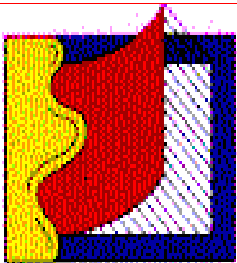


# B-side Formulations

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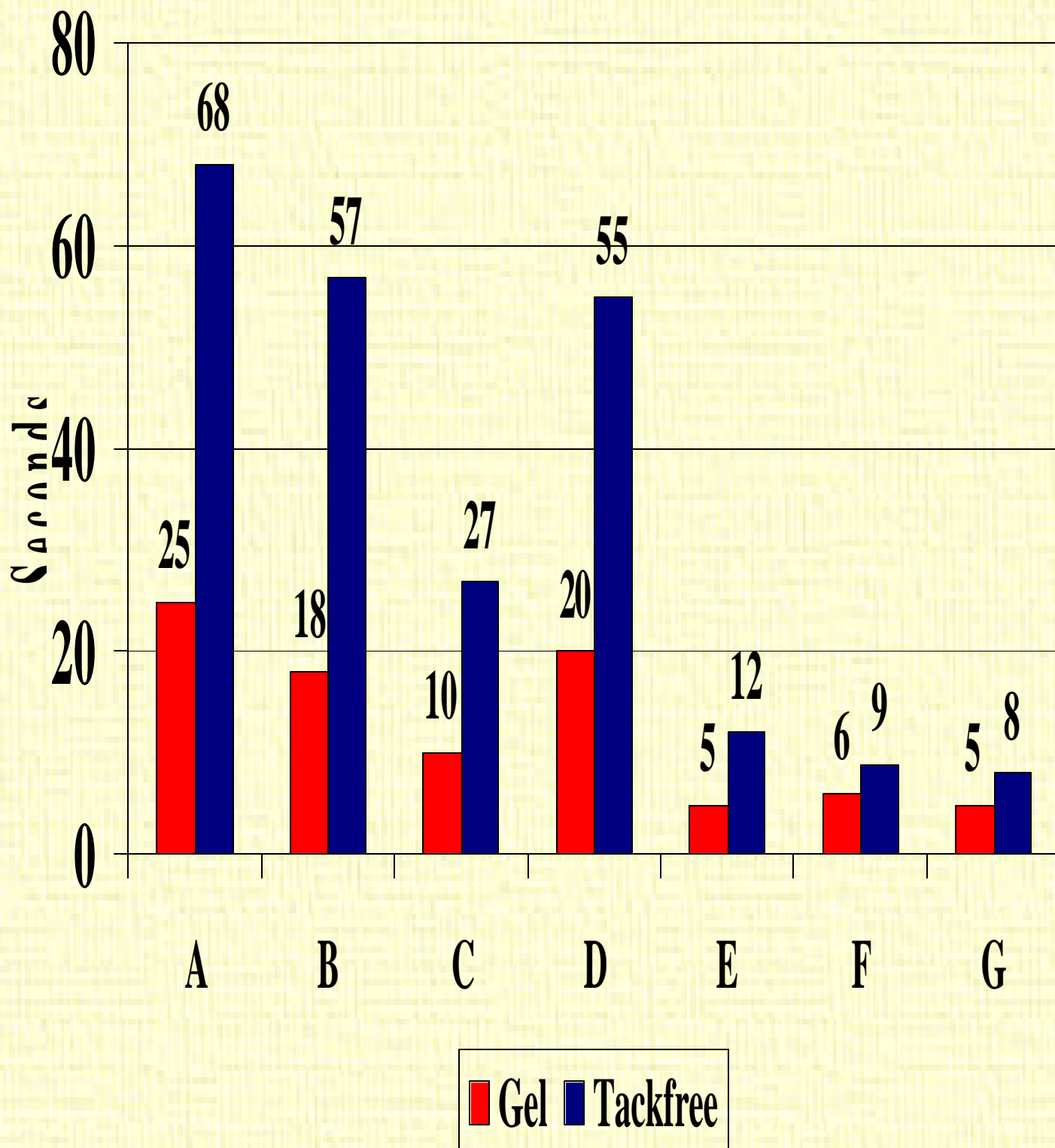
Isocyanate	A	B	C	D	E	F	G
RUBINATE 9272 MDI	100	90					
SUPRASEC 9524 MDI			100	90			
RUBINATE 9447 MDI					100		
RUBINATE 9483 MDI						100	
RUBINATE 9480MDI							100
JEFFSOL® PC		10		10			

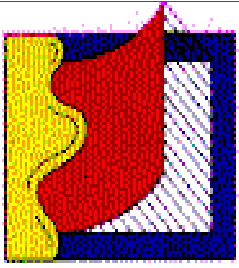
JEFFAMINE D-2000 amine	74.1	72.8	66.4	68.2	59.8	54.8	54.8
JEFFAMINE T-5000 amine	9.9	9.4	8.5	9.1	10.9	9.6	9.6
ETHACURE 100 amine	6.13	7.3	13.1	11.4	18.5	25.4	25.4
JEFFAMINE D-400 amine	8.9	0	0	0	0	0	0
TIOXIDE® TiO2 TR-90	0	10.5	10.7	11.3	10.9	10.2	10.2
SILQUEST A- 187 Silane	0.9	0	0.9	0	0	0.9	0.9



# Reactivity of Spray Polyurea Prepolymers

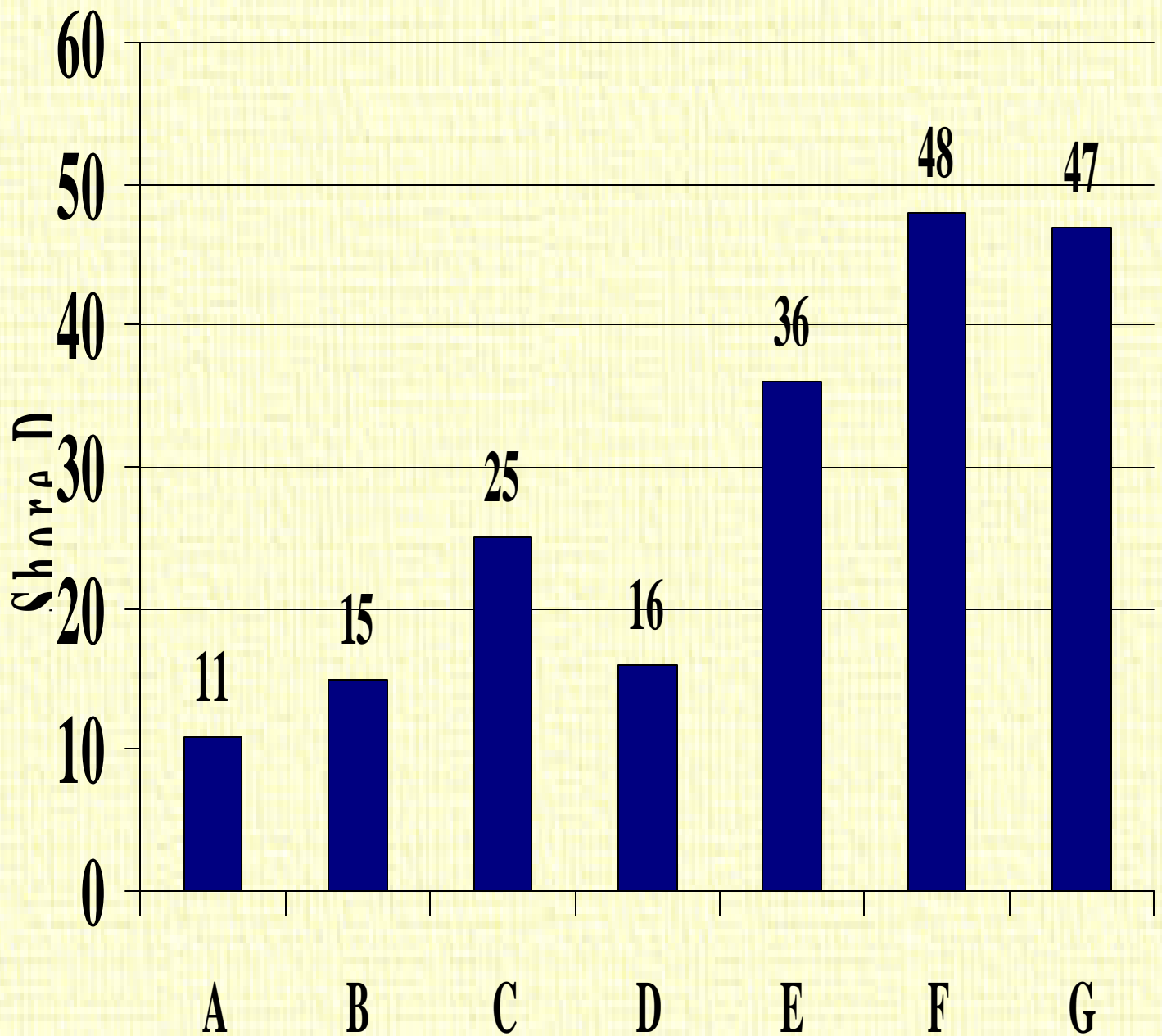
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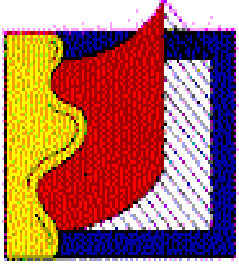


# Hardness of Spray Polyurea Coatings

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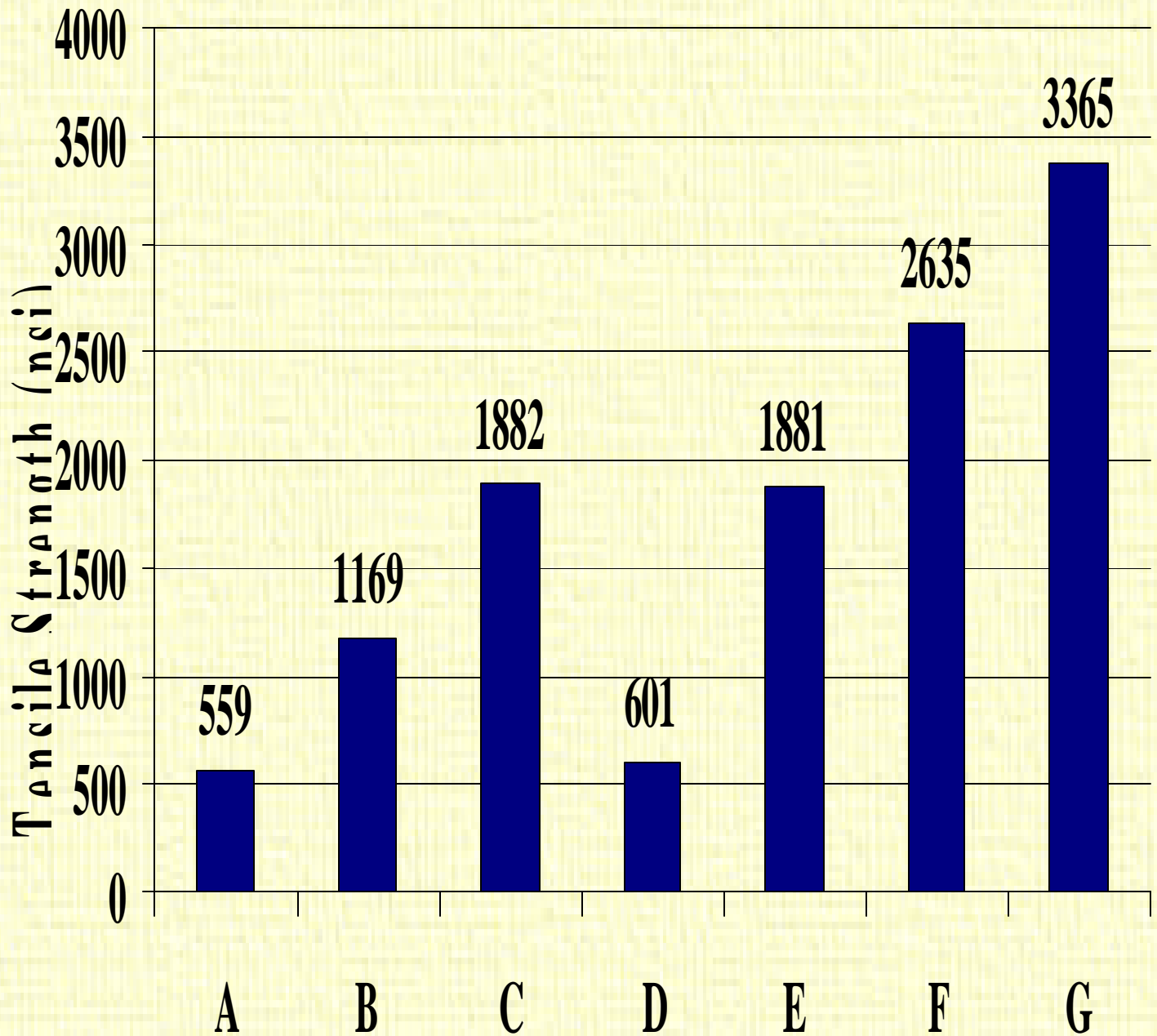


■ Shore D ASTM D-2240-95



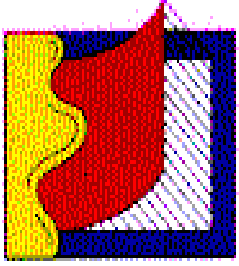
# Tensile Strength of Spray Polyurea Coatings

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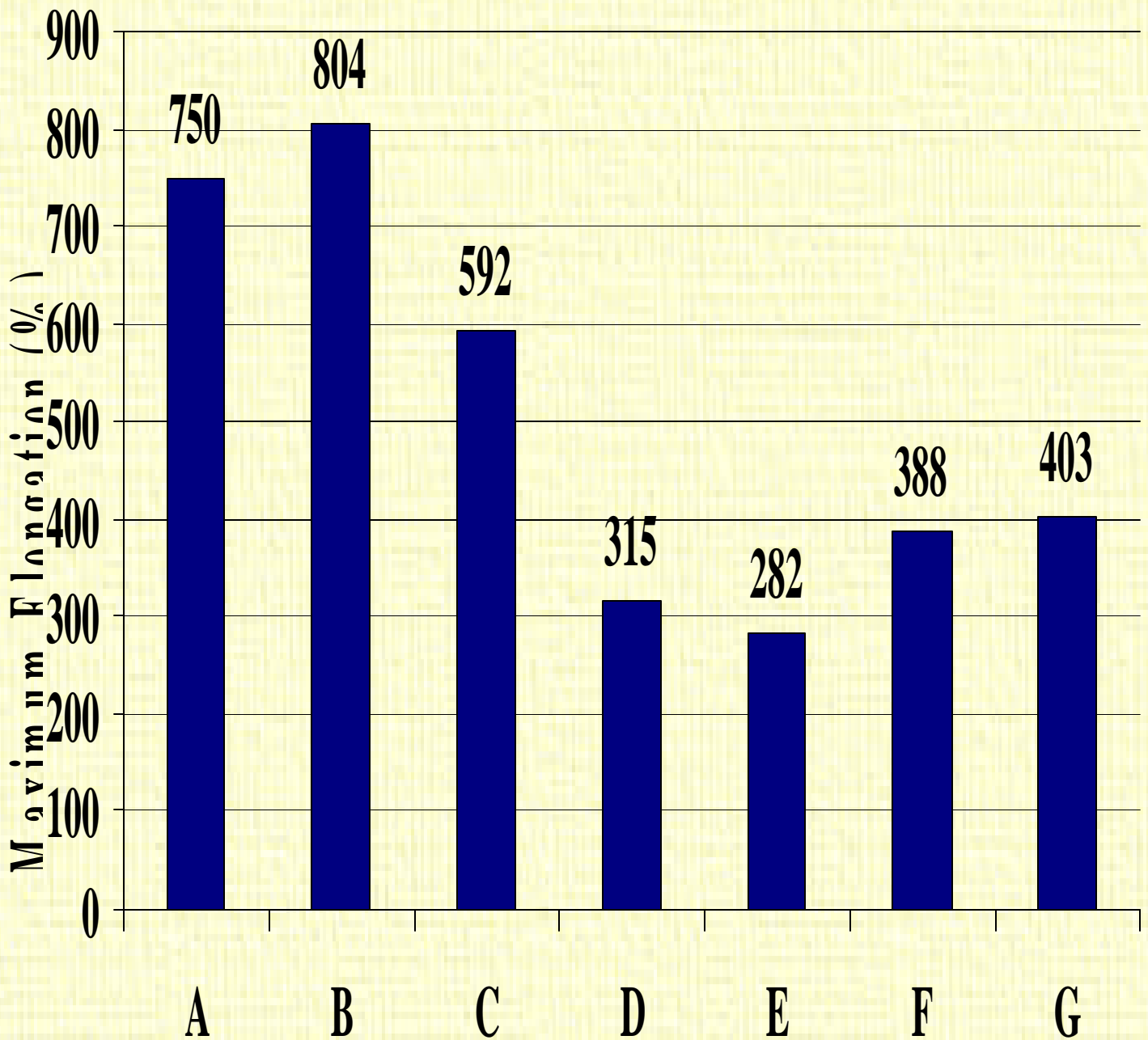
**ASTM D412-92**

**■ Tensile Strength**



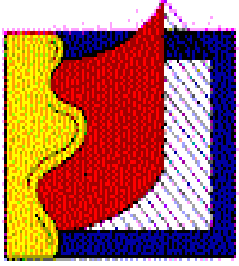
# Maximum Elongation of Spray Polyurea Coatings

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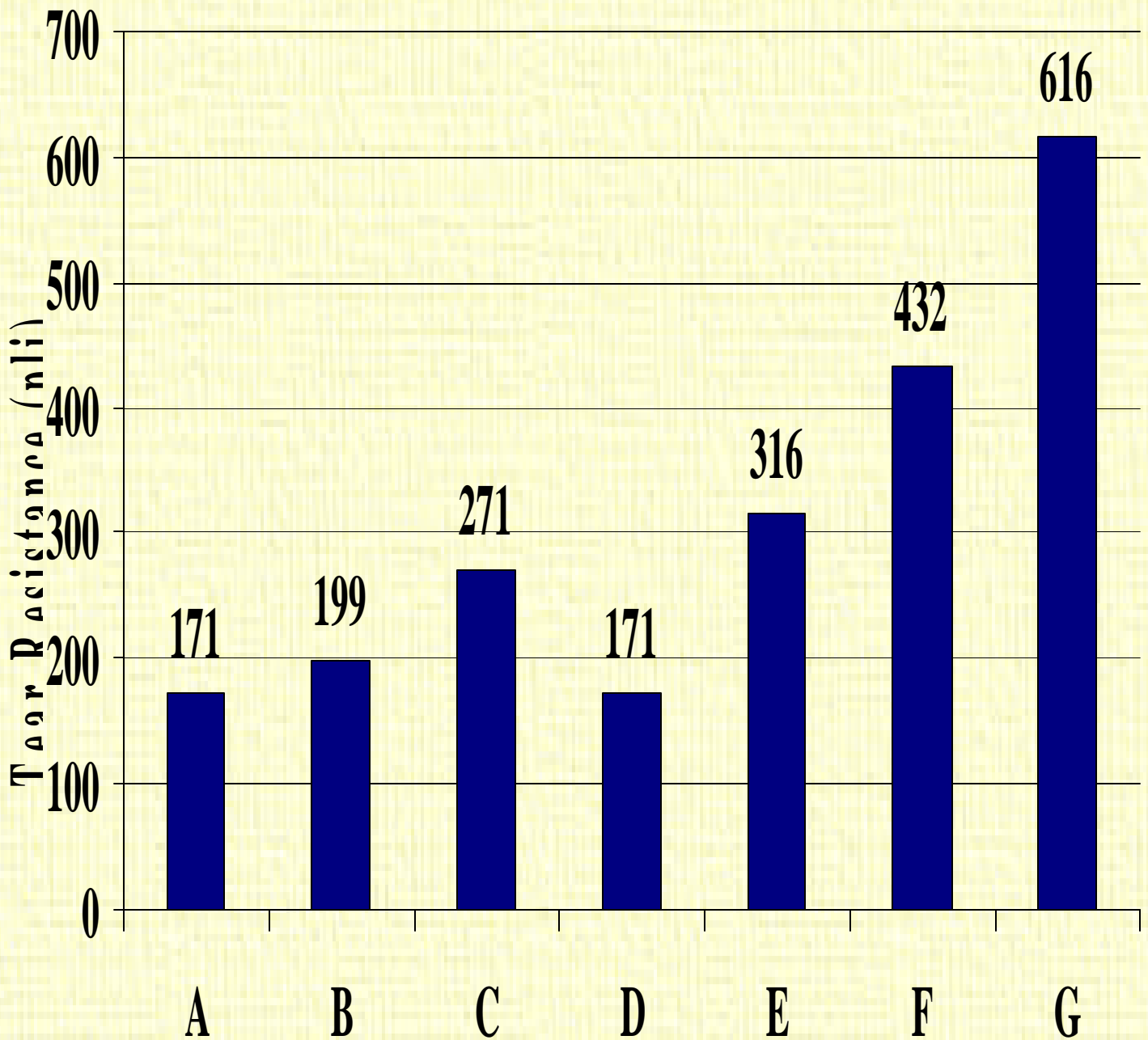
ASTM D412-92

■ Elongation



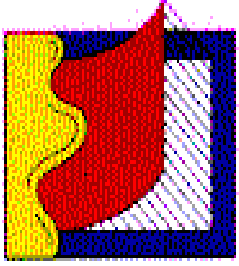
# Tear Resistance of Spray Polyurea Coatings

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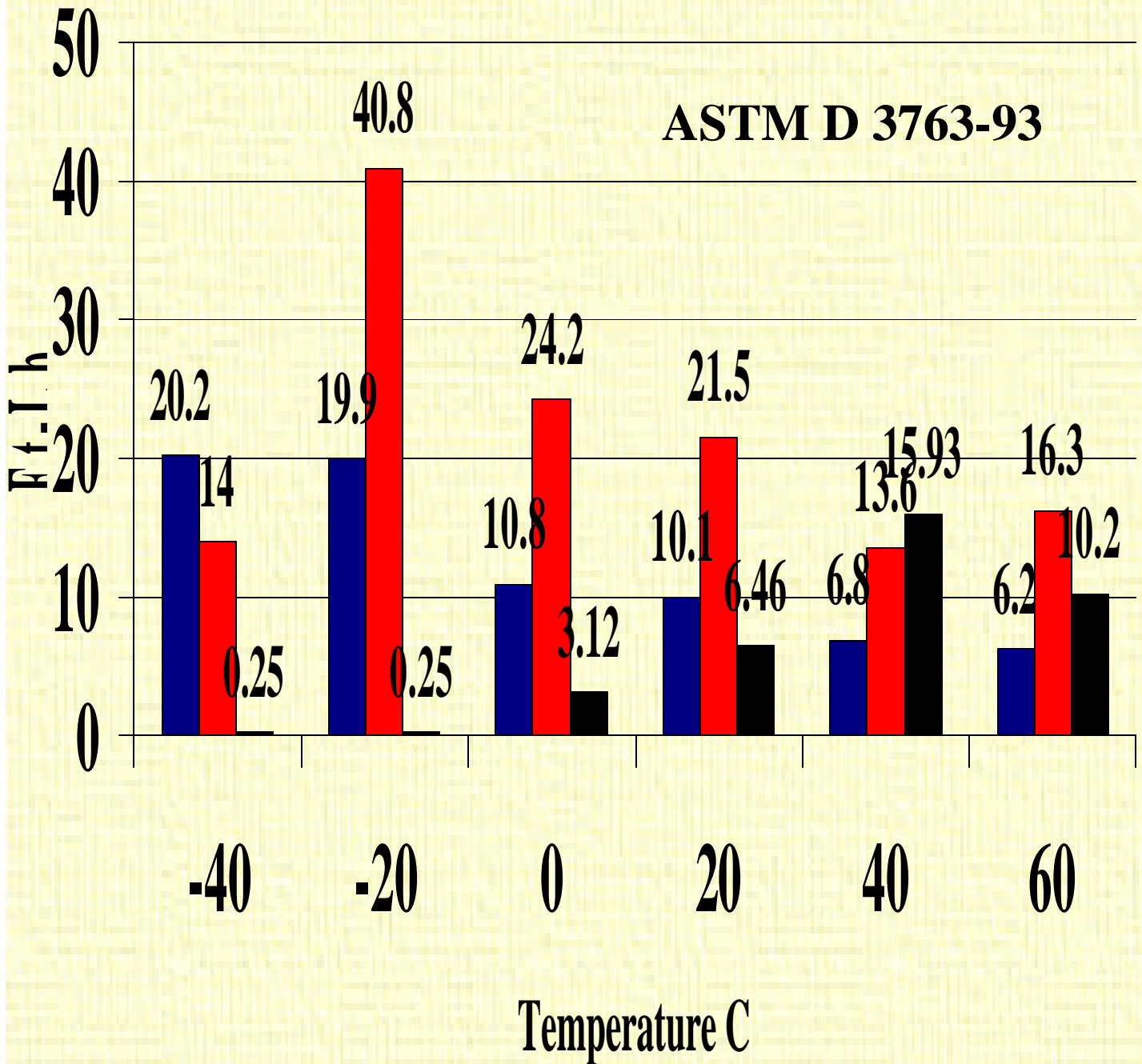
**ASTM D624-91**

**■ Tear Resistance**



# Impact Resistance of Spray Polyurea Coatings

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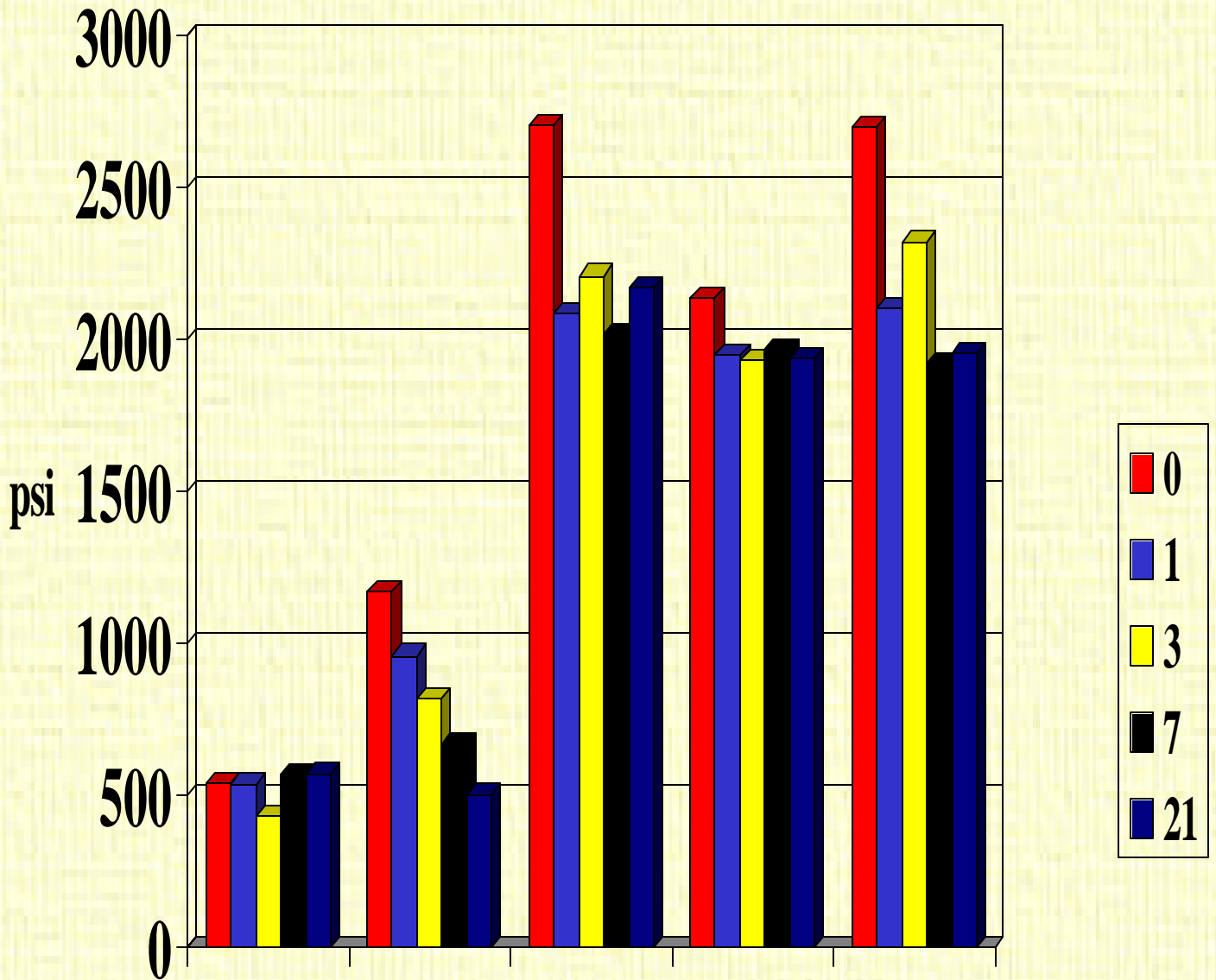


RUBINATE 9272 MDI ■ RUBINATE 9524 MDI ■ RUBINATE 9480 MDI



# Sulfuric Acid (25 %) Resistance of Polyurea Coatings

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SUPRASEC  
9524 MDI

RUBINATE  
9447 MDI

RUBINATE  
9480 MDI

RUBINATE  
9009 MDI

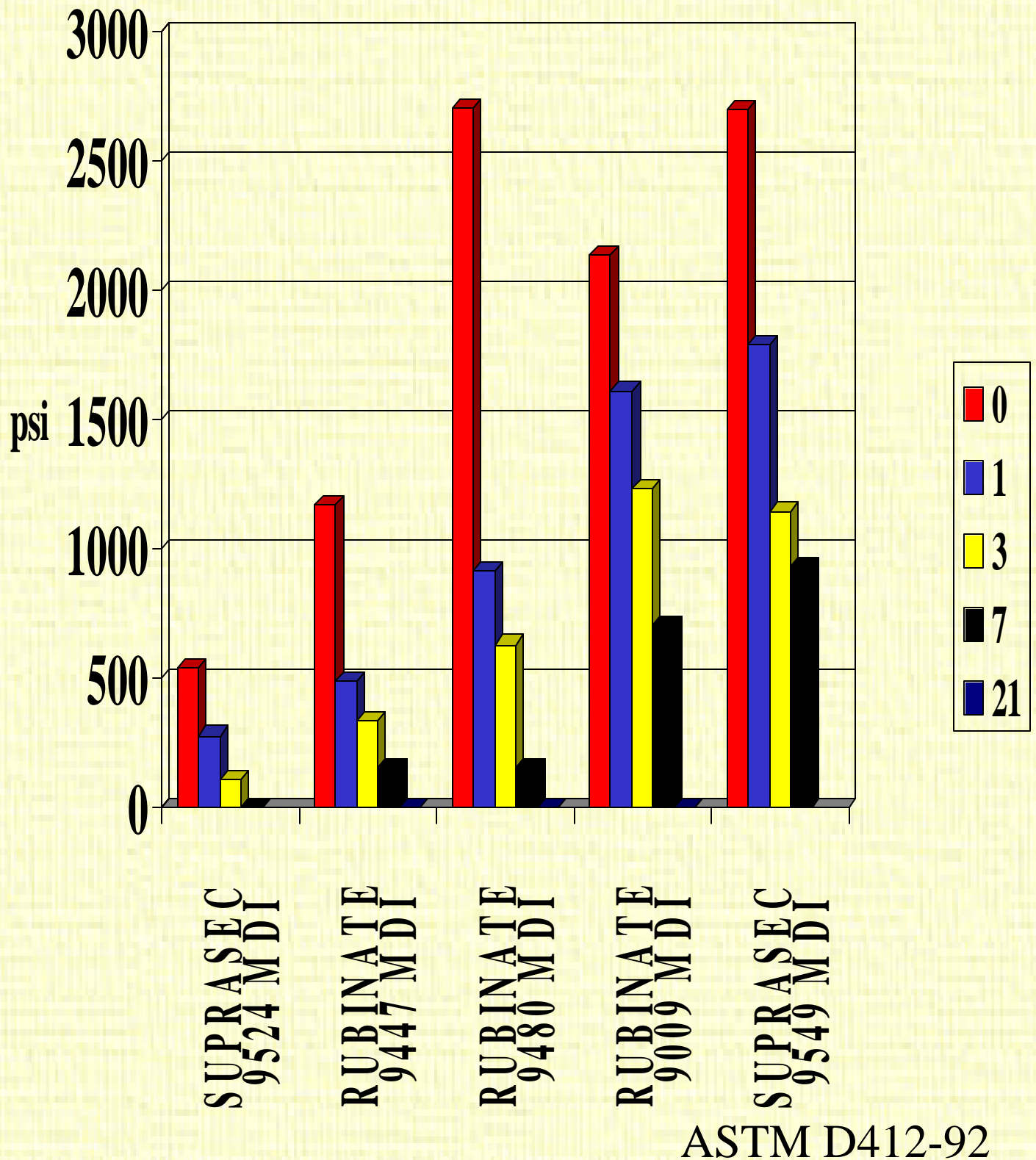
SUPRASEC  
9549 MDI

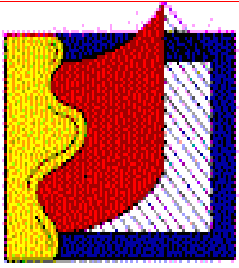
ASTM D412-92



# Nitric Acid (25 %) Resistance of Polyurea Coatings

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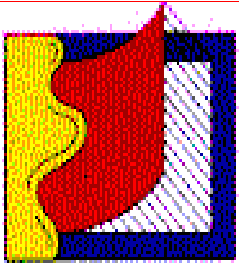


# Conclusions

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- Softer coatings are prepared with low NCO content prepolymer
- Lower hard block content coatings have longer gel and tack free times
- Lower hard block content coatings have lower tensile strength and tear resistance
- Lower hard block content coatings have greater elongation properties
- Lower hard block content coatings have greater impact resistance and flexibility at lower temperatures
- Higher hardblock content coatings had better solvent and acid resistance
- RUBINATE 9009 MDI and RUBINATE 9549 MDI gave the best overall solvent and acid resistance



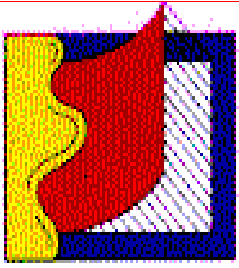
Thanks

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## Huntsman Polyurethanes

- Samantha Smith
- Donna Klaich
- John Andrianos
- Julie Wilson
- Nadatta Green
- David Laganella
- Jeffrey Smith - spray application

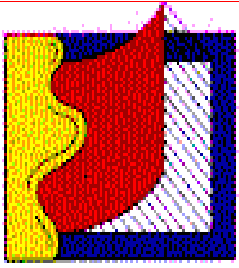


## Contact

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## Contact

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