

A DUAL MEETING

# PLASTICS IN PACKAGING

*National Technical Conference*

*November 13-15 1978*

*Hyatt Regency O'Hare - Chicago, Illinois*

# ACRYLONITRILE



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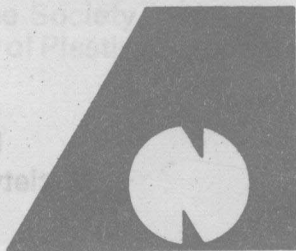
# **PLASTICS IN PACKAGING**

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## **ACRYLONITRILE**



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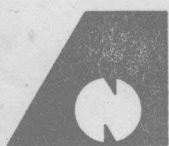
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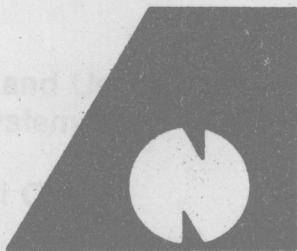
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# PERFORMANCE CONTRIBUTIONS OF NYLON 6 LAYERS IN MULTI-LAYER PACKAGES

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## Introduction

Nylon has been used for almost twenty years as a packaging material. Recent developments in materials, processing and applications technology have greatly increased the potential value of nylon to package designers. This paper will review several of these developments and comment on their significance to the packaging industry.

Nylon brings several very valuable properties to a package: mechanical toughness, impact resistance, abrasion resistance, barrier to oxygen, other gasses, odors, flavors and petroleum. But the major weakness of nylon—poor resistance to permeation by water—requires that for most applications, nylon be used as a composite construction with other materials. Much of the recently developed technology relates to optimum materials to combine with nylon.

## MATERIALS

### Properties of Nylon 6

Chart I lists properties which may be considered representative for nylon layers.

### Adhesion

Traditional nylon laminates have used adhesive laminations and extrusion laminations to achieve acceptable adhesion between layers of composite constructions. Nylon has very poor adhesion to polypropylene and polyethylenes.

## CHART I

### Nylon 6 Film Properties (1 mil @ 50% RH and 72°F)

#### I PHYSICAL AND MECHANICAL

Melting Point, °F	424-428	Hot Stage Microscope
Specific Gravity	1.13	ASTM D 1505-60T
Yield, in <sup>2</sup> /lb/mil	24,500	
Tensile Strength, psi	9,000-12,000 MD 10,000-13,000 TD	ASTM D 882-61T
Elongation, %	350-400 MD 400-500 TD	
Tensile Modulus, psi	90,000-110,000 MD 105,000-125,000 TD	ASTM D 1530-58T
Tear Strength, Initial (Graves), gm/mil	500-600 MD 470-520 TD	ASTM D 1004-61
Tear Strength, Propagated (Elmendorf), gm	50-90 MD 50-70 TD	ASTM D 1922-61T
Burst Strength	Does Not Burst (16-18 psi)	Mullen
Impact Strength (Ave) kg - cm	4.4	T.M. Long machine, 1/2" steel ball, velocity 270 ft/sec
Abrasion Resistance, mg (weight loss/1000 cycles)	2.7-2.9	Tabor abrader CS-10F wheel, 1000 gm per wheel
Flexibility	>250,000 MD >250,000 TD	MIT Fold Endurance Tester



## II THERMAL

Melting Point, °F	424-428	Hot Stage Microscope
Thermal Coefficient of Linear Expansion per °F	$4.6 \times 10^{-5}$ (Dry)	ASTM D 696-44
Coefficient of Thermal Conductivity - Btu/hr/ft <sup>2</sup> /°F/in	1.7 (Dry)	
Specific Heat - Btu/lb - °F	.4 (Dry)	
Cold Brittleness, °F	< -75	Mashland (Com. Std. 192-53, Sec. 4.9)
Service Temp., °F		
Continuous	~200	
Short-time (15 min)	~350	
Dimensional Change (Shrinkage), %	< 2 MD < 2 TD	ASTM D 1204-45 Exposed 30 min @ 300°F in air circulating oven

## III OPTICAL

Haze, %	1.5-4.5	ASTM D 1003-61
Gloss	70-100	20% Gardner Gloss-Meter

## IV BARRIER (DRY)

O <sub>2</sub>	2.6 cc/mil/ 100 in <sup>2</sup> / 24 hr/atm - 73°F	Linde Permeability Cell
N <sub>2</sub>	0.9	
CO <sub>2</sub>	9.7	
Odors, Flavors	Excellent	

## V MOISTURE

Water Vapor Transmission Rate	0.6 gm/100 in <sup>2</sup> /24 hr - 73°F and 50% RH	Pouch Method
Water Resistance	Good to Poor	E 96
High Relative Humidity	Good to Poor	D 756
Water Absorption, 24 hrs, %	9.5	

## VI LIQUID PERMEABILITY - 72°F & 50% RH

Genesolve® (Trichlorotrifluoroethylene)	0.00 gm/100 in <sup>2</sup> /24 hr	Pouch Method
Vegetable Oil	0.00	
Motor Oil	0.00	
Trichloroethylene	0.05	

## VII CHEMICAL RESISTANCE

Strong Acids	Poor	D-543
Strong Alkalies	Good	D-543
Grease & Oils	Good	D-722
Organic Solvents	Good	D-543
Water	Good to Poor	E-96
High Relative Humidity	Good to Poor	D-756

## VIII RADIATION

Sunlight	Fair to Good	D-1435
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