

What Every Chemical Technologist Wants to Know...

Polymers and Plastics

Compiled by Michael and Irene Ash

What Every Chemical Technologist Wants to Know About...

Volume VI

Polymers and Plastics

**Compiled by
Michael and Irene Ash**

Edward Arnold

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PREFACE

This reference book is the sixth volume in the set of books entitled WHAT EVERY CHEMICAL TECHNOLOGIST WANTS TO KNOW . . . SERIES. This compendium serves a unique function for those involved in the chemical industry—it provides the necessary information for making the decision as to which trademark chemical product is most suitable for a particular application.

The chemicals included in this sixth book of the series are polymers and plastic materials, however, complete cross-referencing is provided for the multiple functions or classification of all the chemicals.

The first section which is the major portion of each volume contains the most common generic name of the chemicals as the main entry. All these generic entries are in alphabetical order. Synonyms for these chemicals are then listed. The CTFA name appears alongside the appropriate generic name. The structural and/or molecular formula of the chemical is listed whenever possible. The generic chemical is sold under various tradenames and these are listed here in alphabetical order for ease of reference along with their manufacturer in parentheses. *Modifications/Specialty Grades* lists those tradenames that contain or omit additives so that they are used for a variety of specialty purposes. The *Category* subheading classifies the polymer by thermoplastic and/or thermoset types, synthetic rubber, or by functionality, as appropriate. The *Processing* category lists the tradenames that have been formulated to be used for specific or generalized plastics processing. Because of differences in form, activity, etc., individual tradenames of the generic chemical are used in particular applications more frequently. These are delineated in the *Applications* section. The differences in properties, toxicity/handling, storage/handling, and standard packaging are specified in the subsequent sections wherever distinguishing characteristics are known.

The second section of the volume TRADENAME PRODUCTS AND GENERIC EQUIVALENTS helps the user who only knows a chemical by one tradename to locate its main entry in section 1. The user can look up the tradename in this section of the book and be referred to the appropriate, main-entry, generic chemical name.

The third section GENERIC CHEMICAL SYNONYMS AND CROSS REFERENCES provides a way of locating the main entries by knowing only one of the synonyms.

If the generic chemical is not in the volume, it will refer you to the volume in which it is contained.

The fourth section **TRADENAME PRODUCT MANUFACTURERS** lists the full addresses of the companies that manufacture or distribute the tradename products found in the first section.

The following is a list of the six volumes that comprise this series:

Volume I	Emulsifiers and Wetting Agents
Volume II	Dispersants, Solvents and Solubilizers
Volume III	Plasticizers, Stabilizers and Thickeners
Volume IV	Conditioners, Emollients and Lubricants
Volume V	Resins
Volume VI	Polymers and Plastics

This series has been made possible through long hours of research and compilation and the dedication and tireless efforts of Roberta Dakan who helped make this distinctive series possible. Our appreciation is extended to all the chemical manufacturers and distributors who supplied the technical information.

M. and I. Ash

NOTE

The information contained in this series is accurate to the best of our knowledge; however, no liability will be assumed by the publisher for the correctness or comprehensiveness of such information. The determination of the suitability of any of the products for prospective use is the responsibility of the user. It is herewith recommended that those who plan to use any of the products referenced seek the manufacturer's instructions for the handling of that particular chemical.

OTHER BOOKS BY MICHAEL AND IRENE ASH

A Formulary of Paints and Other Coatings, Volumes I and II
A Formulary of Detergents and Other Cleaning Agents
A Formulary of Adhesives and Sealants
A Formulary of Cosmetic Preparations
The Thesaurus of Chemical Products, Volumes I and II
Encyclopedia of Industrial Chemical Additives, Volumes I-IV
Encyclopedia of Surfactants, Volumes I-IV
Encyclopedia of Plastics, Polymers and Resins, Volumes I-IV
What Every Chemical Technologist Wants to Know About. . .
 Volume I—Emulsifiers and Wetting Agents
 Volume II—Dispersants, Solvents and Solubilizers
 Volume III—Plasticizers, Stabilizers and Thickeners
 Volume IV—Conditioners, Emollients, and Lubricants
 Volume V—Resins
Chemical Products Desk Reference

ABBREVIATIONS

@	.....	at
anhyd.	.....	anhydrous
APHA	.....	American Public Health Association
approx.	.....	approximately
aq.	.....	aqueous
ASTM	.....	American Society for Testing and Materials
avg.	.....	average
B.P.	.....	boiling point
Btu	.....	British thermal unit
C	.....	degrees Centigrade
CAS	.....	Chemical Abstracts Service
cc	.....	cubic centimeter(s)
CC	.....	closed cup
cm	.....	centimeter(s)
cm ³	.....	cubic centimeter(s)
COC	.....	Cleveland Open Cup
compd.	.....	compound, compounded
conc.	.....	concentrated, concentration
cP, cps	.....	centipoise
cs, cSt	.....	centistokes
CTFA	.....	Cosmetic, Toiletry and Fragrance Association
DEA	.....	diethanolamine
disp	.....	dispersible, dispersion
dist	.....	distilled
DOT	.....	Department of Transportation
DW	.....	distilled water
EO	.....	ethylene oxide
equiv.	.....	equivalent
F	.....	degrees Fahrenheit
F.P.	.....	freezing point
FDA	.....	Food and Drug Administration
ft ³	.....	cubic foot, cubic feet
g	.....	gram(s)
gal	.....	gallon(s)
HLB	.....	hydrophile-lipophile balance
insol.	.....	insoluble
IPA	.....	isopropyl alcohol
kg	.....	kilogram(s)
l, L	.....	liter(s)
lb	.....	pound(s)
max	.....	maximum
M.D.	.....	mold direction
MEA	.....	monoethanolamine
MEK	.....	methyl ethyl ketone
mfg.	.....	manufacture
MIBK	.....	methyl isobutyl ketone
min	.....	minute(s)
min.	.....	mineral, minimum
MIPA	.....	monoisopropanolamine
misc.	.....	miscible

ml.....	milliliter(s)
mm.....	millimeter(s)
M.P.....	melting point
M.W.....	molecular weight
NF.....	National Formulary
no.....	number
o/w.....	oil-in-water
OC.....	open crucible
PEG.....	polyethylene glycol
pH.....	hydrogen-ion concentration
pkgs.....	packages
PMCC.....	Pensky Marten closed cup
POE.....	polyoxyethylene, polyoxyethylated
POP.....	polyoxypropylene
PPG.....	polypropylene glycol
pt.....	point
R&B.....	Ring & Ball
RD.....	Recognized Disclosure
ref.....	refractive
rpm.....	revolutions per minute
R.T.....	room temperature
s.....	second(s)
sol.....	soluble, solubility
sol'n.....	solution
sp.gr.....	specific gravity
SS.....	stainless steel
std.....	standard
SUS.....	Saybolt Universal seconds
TCC.....	Taggart closed cup
T.D.....	transverse direction
TEA.....	triethanolamine
tech.....	technical
temp.....	temperature
theoret.....	theoretical
TLV.....	threshold limit value
TOC.....	Taggart open cup
UL.....	Underwriter's Laboratory
USP.....	United States Pharmacopoeia
uv, UV.....	ultraviolet
veg.....	vegetable
visc.....	viscosity, viscous
w/o.....	water-in-oil
wt.....	weight
≈.....	approximately equal to
<.....	less than
>.....	greater than
≤.....	less than or equal to
≥.....	greater than or equal to

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Acrylamides copolymer (CTFA)

TRADENAME EQUIVALENTS:

Reten 521 [Hercules]

Rheolate 1 [NL Treating]

CATEGORY:

Gelling agent, thickener, flocculating agent, retention aid, slip agent, antistat, film former, suspending agent, crosslinking agent

APPLICATIONS:

Industrial applications: adhesives (Rheolate 1; Reten 521); coatings (Rheolate 1); latexes (Rheolate 1); paints (Rheolate 1); paper and pulp industry (Reten 521)

PROPERTIES:

Form:

Emulsion (Rheolate 1)

Powder (Reten 521)

Color:

White (Reten 521)

Milky white (Rheolate 1)

Composition:

30% nonvolatiles in water (Rheolate 1)

GENERAL PROPERTIES:

Ionic Nature:

Anionic (Reten 521)

Solubility:

Sol. in alkali (Rheolate 1)

Dissolves readily in water (Reten 521)

Density:

1.07 g/cm³ (Rheolate 1)

705 kg/m³ (Reten 521)

Visc.:

3300 cps (1%) (Reten 521)

Acrylamide/sodium acrylate copolymer (CTFA)

SYNONYMS:

2-Propenamide, polymer with 2-propenoic acid, sodium salt

2-Propenoic acid, sodium salt, polymer with 2-propenamide

EMPIRICAL FORMULA:



CAS No.:

25085-02-3

TRADENAME EQUIVALENTS:

Reten 421, 423, 425 [Hercules]

CATEGORY:

Thickener, suspending agent, flocculant, slip agent, antistat, film-former, adhesive, crosslinking agent

PROPERTIES:

Form:

Powder (Reten 421, 423, 425)

GENERAL PROPERTIES:

Ionic Nature:

Anionic

Solubility:

Sol. in warm or cold water (Reten 421, 423, 425)

Acrylates/steareth-20 methacrylate copolymer (CTFA)

TRADENAME EQUIVALENTS:

Acrysol ICS-1 [Rohm & Haas]

CATEGORY:

Thickener

APPLICATIONS:

Consumer products: cosmetics/toiletries (Acrysol ICS-1); household cleaners (Acrysol ICS-1)

Industrial applications: industrial cleaners (Acrysol ICS-1)

PROPERTIES:

Form:

Liquid emulsion (Acrysol ICS-1)

GENERAL PROPERTIES:

Solubility:

Sol. in alkali (Acrysol ICS-1)

Acrylonitrile-butadiene copolymer

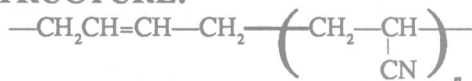
SYNONYMS:

Acrylonitrile rubber
Acrylonitrile-butadiene rubber
Butadiene-acrylonitrile copolymer
NBR
Nitrile-butadiene rubber
Nitrile rubber

EMPIRICAL FORMULA:



STRUCTURE:



TRADENAME EQUIVALENTS:

Chemigum NBR Polymers [Goodyear]
Darex 110L [W.R. Grace]
Hycar 1312, 1422, 1422X8, 1452P50, Butadiene-Acrylonitrile Rubber, Nitrile, Nitrile Latexes [Goodrich]
Krynac 19.65, 21.65, 25.65, 27.50, 29.60, 32.55, 34.35, 34.50, 34.80, 34.140, 34.E50, 34.E80, 38.50, 40.65, 45.55, 50.75, 800, 803, 810, 822, 825, 826, 826, 843 [Polysar]
Nobestos/D-7280 [Rogers]
Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810 [Bayer AG]
Perbunan N Latex 1590, 3090, 2818, 3310, 3310HD, 3810, 3415 M, T, VT [Bayer AG]

MODIFICATIONS/SPECIALTY GRADES:

Carboxy-modified:

Hycar Nitrile

Cross-linked:

Krynac 810

DOP-modified:

Krynac 843 (50 phr DOP)

CATEGORY:

Synthetic rubber

PROCESSING:

Calendering:

Krynac 803, 810

Compression molding:

Krynac 800

Extrusion:

Krynac 34.E50, 34.E80, 810

Acrylonitrile-butadiene copolymer (cont'd.)

Injection molding:

Krynac 27.50, 29.60, 34.35, 822, 825, 826, 827

APPLICATIONS:

Automotive applications: brake/clutch linings (Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810; Perbunan N Latex 1590, 2818, 3090, 3310, 3310 HD, 3415 M, 3810, T, VT); door panels (Chemigum NBR Polymers); fuel diaphragms (Krynac 50.75); timing chain bumper (Hycar Nitrile)

Consumer products: footwear (Chemigum NBR Polymers; Hycar Butadiene-Acrylonitrile Rubber; Krynac 34.35, 34.50, 803, 826; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810)

Electrical/electronic industry: cable and wire jacketing (Chemigum NBR Polymers; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810)

Functional additives: binder (Perbunan N Latex 1590, 2818, 3090, 3310, 3310 HD, 3415 M, 3810, T, VT); impact modifier (Krynac 810); plasticizer (Hycar 1312, 1422, 1422X8, 1452P50, Butadiene-Acrylonitrile Rubber; Krynac 34.140, 810, 843); viscosity modifier (Krynac 34.140)

Industrial applications: adhesives (Hycar Nitrile Latexes; Krynac 38.50; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); belting/belt covers (Krynac 19.65, 21.65, 32.55, 34.50, 38.50, 800, 803, 825; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); coatings (Hycar Nitrile Latexes); conveyor belts (Hycar Butadiene-Acrylonitrile Rubber); diaphragms (Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); dipped goods (Perbunan N Latex 1590, 2818, 3090, 3310, 3310 HD, 3415 M, 3810, T, VT); drive wheels (Hycar Nitrile); fabric proofings (Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810; Perbunan N Latex 1590, 2818, 3090, 3310, 3310 HD, 3415 M, 3810, T, VT); friction stocks (Krynac 34.35); gaskets/seals (Krynac 25.65, 32.55, 40.65, 800, 822; Nobestos/D-7280; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810; Perbunan N Latex 1590, 2818, 3090, 3310, 3310 HD, 3415 M, 3810, T, VT); inks (Hycar Nitrile Latexes); insulation (Chemigum NBR Polymers); mechanical goods (Krynac 843); molded goods (Krynac 27.50, 29.60, 34.35, 826, 827); oil seals (Hycar Butadiene-Acrylonitrile Rubber); packings (Krynac 34.50, 34.80, 38.50, 40.65); paper and felt industries (Darex 110L; Hycar Nitrile Latexes); paper coatings (Perbunan N Latex 1590, 2818, 3090, 3310, 3310 HD, 3415 M, 3810, T, VT); petroleum industry (Krynac 19.65, 21.65, 40.65, 825); plastics modification (Hycar 1422, 1422X8, 1452P50, Butadiene-Acrylonitrile Rubber; Krynac 810); plastisols (Hycar 1312); printer rolls/blankets (Chemigum NBR Polymers; Krynac

Acrylonitrile-butadiene copolymer (cont'd.)

32.55, 34.50, 34.80, 50.75, 800; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); pumps (Krynac 822, 826); rollers/roll covers (Hycar Butadiene-Acrylonitrile Rubber, Nitrile; Krynac 19.65, 21.65, 25.65, 34.35, 34.50, 34.E50, 34.E80, 38.50, 803, 843; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); rubber (Hycar 1312); sponge rubber (Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); textile applications (Hycar Nitrile Latices); textile coatings (Perbunan N Latex 1590, 2818, 3090, 3310, 3310 HD, 3415 M, 3810, T, VT); tubing/hoses/fuel hoses (Hycar Butadiene-Acrylonitrile Rubber; Krynac 25.65, 27.50, 29.60, 34.50, 34.80, 34.E50, 34.E80, 40.65, 45.55, 800, 827; Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); valves (Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810); vibration damping (Perbunan N 1807 NS, N 2802 NS, N 2807 NS, N 2810, N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810)

Marine equipment: fuel hose (Krynac 45.55, 50.75)

PROPERTIES:

Form:

Liquid (Chemigum NBR Polymers; Hycar 1312)

Powder (Hycar 1422, 1422X8, 1452P50, Butadiene-Acrylonitrile Rubber)

Solid (Hycar Butadiene-Acrylonitrile Rubber, Nitrile)

Bales (Perbunan N 2818 NS, N 3302 NS, N 3307 NS, N 3310, N 3312 NS, N 3807 NS, N 3810)

Crumb (Perbunan N 2818 NS, N 3810)

Composition:

15% ACN (Perbunan N Latex 1590)

18 ± 1% ACN (Perbunan N 1807 NS)

19% bound ACN (Krynac 19.65)

21% bound ACN (Krynac 21.65)

25% bound ACN (Krynac 25.65)

27% ACN (Perbunan N Latex 2818); 27% bound ACN (Krynac 27.50)

28 ± 1% ACN (Perbunan N 2802 NS, N 2807 NS, N 2810, N 2818 NS)

29% bound ACN (Krynac 29.60, 827)

30% ACN (Perbunan N Latex 3090, VT); 30% bound ACN (Krynac 810)

32% ACN (Perbunan N Latex 3310, 3310 HD); 32% bound ACN (Krynac 32.55, 822)

33% ACN (Perbunan N Latex 3415 M)

34% bound ACN (Krynac 34.35, 34.50, 34.80, 34.140, 34.E50, 34.E80, 800, 803, 843)

34 ± 1% ACN (Perbunan N 3302 NS, N 3307 NS, N 3310, N 3312 NS)

35% ACN (Perbunan N Latex T)

36% bound ACN (Krynac 825, 826)

37% ACN (Perbunan N Latex 3810)

Acrylonitrile-butadiene copolymer (cont' d.)

38% bound ACN (Krynac 38.50)
39 ± 1% ACN (Perbunan N 3807 NS, N 3810)
40% bound ACN (Krynac 40.65)
40% solids (Perbunan N Latex 1590, 3090, 3310 HD)
45% bound ACN (Krynac 45.55)
45% solids (Perbunan N Latex 2818, 3310, 3810, VT)
47% solids (Darex 110L)
47.5% solids (Perbunan N Latex 3415 M)
50% bound ACN (Krynac 50.75)
50% solids (Perbunan N Latex T)

GENERAL PROPERTIES:

Solubility:

Sol. in acetone (Hycar 1312, 1452P50)
Sol. in MEK (Hycar 1312, 1452P50)

Sp. Gr.:

0.96 (Krynac 19.65, 21.65, 25.65, 27.50; Perbunan N 1807 NS)
0.97 (Krynac 29.60, 827)
0.98 (Krynac 32.55, 34.35, 34.50, 34.80, 34.140, 34.E50, 34.E80, 38.50, 800, 803, 810, 822, 825, 826; Perbunan N 2802 NS, N 2807 NS, N 2810, N 2818 NS; Perbunan N Latex 2818, 3810, 3415 M, T)
0.99 (Krynac 40.65; Perbunan N 3302 NS, N 3307 NS, N 3310, N 3312 NS; Perbunan N Latex 1590, 3310, 3310 HD)
0.998 (Perbunan N Latex VT)
0.999 (Perbunan N Latex 3090)
1.00 (Krynac 45.55, 50.75; Perbunan N 3807 NS, N 3810)

Density:

8.4 lb/gal (Darex 110L)

Visc.:

30 cps (Darex 110L)
Mooney 30 ± 5 (ML4, 100 C) (Perbunan N 2802 NS, N 3302 NS)
Mooney 35 (100 C) (Krynac 34.35)
Mooney 38 (100 C) (Krynac 843)
Mooney 40 (100 C) (Krynac 826)
Mooney 45 ± 5 (ML4, 100 C) (Perbunan N 1807 NS, N 2807 NS, N 3307 NS, N 3807 NS)
Mooney 47 (100 C) (Krynac 803, 822, 825)
Mooney 48 (100 C) (Krynac 827)
Mooney 50 (100 C) (Krynac 27.50, 34.50, 34.E50, 38.50)
Mooney 55 (100 C) (Krynac 32.55, 45.55)
Mooney 60 (100 C) (Krynac 29.60, 810)
Mooney 65 (100 C) (Krynac 19.65, 21.65, 25.65, 40.65)
Mooney 65 ± 7 (ML4, 100 C) (Perbunan N 2810, N 3310, N 3810)
Mooney 75 (100 C) (Krynac 50.75)

Acrylonitrile-butadiene copolymer (cont'd.)

Mooney 79 (100 C) (Krynac 800)

Mooney 80 (100 C) (Krynac 34.80, 34.E80)

Mooney 80 ± 5 (ML4, 100 C) (Perbunan 3312 NS)

Mooney 95 ± 7 (ML4, 100 C) (Perbunan N 2818 NS)

Mooney 140 (100 C) (Krynac 34.140)

pH:

4.5–5.5 (Perbunan N Latex 3090)

5.5–6.5 (Perbunan N Latex 3415 M, T)

7.0 (Darex 110L)

7.0–8.0 (Perbunan N Latex 1590)

8.0–9.0 (Perbunan N Latex VT)

10–12 (Perbunan N Latex 2818, 3310, 3310 HD, 3810)

Surface Tension:

40 dynes/cm (Darex 110L)

MECHANICAL PROPERTIES:

Tens. Str.:

13.8 MPa (Nobestos/D-7280)

Adipic acid/dimethylaminohydroxypropyl diethylenetriamine copolymer (CTFA)

STRUCTURE:

