Handbook of Industrial Surfactants

Fourth Edition
Volume 2

Compiled by
Michael and Irene Ash

Synapse Information Resources, Inc.

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Preface

The surfactant industry is complex because of the multitude of markets served, diversity of product types, dynamic changes in product names and manufacturers, and the development of new products. This two-volume reference set, in its fourth edition, serves to integrate information on surfactant chemicals and materials that are presently available throughout the world. Since the publication of the last edition of this reference, many products have been discontinued or acquired by different manufacturers and thousands of new trade name products and generic chemicals have been added to this reference.

Surfactants are versatile materials that function as: antifoamers, defoamers, detergents, dispersants, emulsifiers, foam builders, foam control agents, foam stabilizers, solubilizers, surface conditioners, surfactant intermediates, surfactant raw materials, and wetting agents. The application areas for surfactant products cover a broad spectrum with the bulk of revenues generated from household detergents and personal care. Surfactants are also important in industrial and institutional cleaning, textiles, emulsion polymerization, oilfield, crop protection, construction, paints and coatings as well as a wide range of other industries because of their multfunctional attributes.

The global surfactant market is valued at more than $14 billion per year. Suppliers are challenged to maintain their position in the marketplace under the pressures of globalization, demand for specialty products, price increases, and environmental constraints. Availability of a variety of surfactants materials from many different sources have added to the complexity of the research and selection process. By providing information gleaned from thousands of sources, this comprehensive reference is essential to all professionals involved in the surfactants field.

This fourth edition has been extensively revised. More than 50% of the entries are new or updated since the publication of the third edition more than five years ago.

Part I— *Trade Name Reference* provides an alphabetical listing of more than 23,000 trade name chemicals and materials that function as surfactants or are used to manufacture surfactants. Entries include: manufacturer's name; chemical description; detailed functions and applications in all aspects of industry; physical properties, such as form, molecular weight, density, solubility, boiling point, cloud point, flash point, pH, freezing point, HLB number, Draves wetting and Ross Miles foam height, activity; ionic nature, toxicology, environmental data, storage requirements, precautions, and hazardous ratings. This information is provided by the manufacturer or derived from other reference sources. Not all entries contain information for every category as product descriptions are dependent, in many cases, on the literature that the individual manufacturers provide.

Part II— *Chemical Component Cross-Reference* covers more than 5400 chemicals and materials that are contained in the trade name products profiled in Part I or are generic chemical and material components that are not linked to trade names but are used for surfactant applications. More than 18,000 generic chemical synonyms are cross-referenced to the main chemical entry. Each entry contains information including the following: CAS (Chemical Abstract Service), EINECS/ELINCS (European Inventory of Existing Commercial Chemical Substances/European List of Notified Chemical Substances), and UN/DOT reference numbers, classification, definition, ionic nature, chemical synonyms, empirical and molecular formulas, properties, toxicology, precautions, storage, uses, use level, regulatory details, manufacturers and distributors. These entries are followed by a listing of the trade name products that are either equivalent to the monograph entry or contain it as one or more of its blended ingredients.

Part III— *Functional/Application Index* is a powerful tool for locating the trade names and chemicals based on their function and/or industrial application area. By searching for key functional words such as defoamer, emulsifier, solubilizer, in a specific application area, such as food, household cleaners, paint, agriculture, etc., the user is directed to the trade names and/or generic chemicals that have that specific functional/application attribute. The generic chemical names are distinguished from the trade names by italic type.

Part IV— *Manufacturers Directory* contains detailed contact information for the more than 3300 worldwide manufacturers and their branches of trade name products and chemical components that are referenced in this handbook. Wherever possible, telephone, fax, toll-free numbers, e-mail and Internet addresses, and complete mailing addresses are included for each manufacturer.

Appendix I— *CAS Number Index* contains CAS number entries followed by a listing of their trade name product and

chemical equivalents in alphabetical order. The chemical name is in boldfaced type.

Appendix II— *EINECS/ELINCS Number Index* contains EINECS/ELINCS number entries followed by a listing of its trade name product and generic chemical equivalents in alphabetical order. The chemical name is in boldfaced type.

Appendix III— *Ionic Classification Index* orders the trade name and generic chemicals based on their principal solubilizing group and consists of four major classes: anionic, cationic, nonionic, amphoteric, and their synergistic blends

Appendix IV— *HLB Classification Index* orders the trade name and generic chemicals based on this scale. It can be used as an indicator for surfactant selection based on functional requirements, e.g., a value of 3-6 for water-in-oil emulsifiers, 7-9 for wetting agents, 8-15 for oil-in-water emulsifiers, 12-15 for detergents, and 15-18 for solubilizers and hydrotropes. However, products with similar HLB values may still exhibit disparate performance because of differences in chemical structure or physical chemistry. These values can be used as one of many criteria for selection but not as an unequivocal indicator.

The ***Glossary*** contains definitions of terminology associated with surfactants and their applications.

We are confident that those involved in any aspect of surfactant technology, including identifying, formulating, purchasing, and/or researching, will find this two-volume set to be an important addition to their reference library. We are also pleased to provide this information as an electronic product.

This reference is the culmination of many years of research, investigation of product sources acquired through personal contacts and correspondences with major chemical manufacturers worldwide, as well as toxicological databases, chemical reference books, trade magazines and journals.

M & I Ash

Abbreviations

abs.	absolute
ABS	acrylonitrile-butadiene-styrene
absorp.	absorption
ACGIH	American Conference of Governmental Industrial Hygienists
ACN	acrylonitrile
act.	active
ADI	acceptable daily intake (FAO/WHO)
ADR	adverse drug reactions
AEL	acceptable exposure limit
adsorp.	adsorption
agric.	agricultural
agrochem.	agrochemical
a.i.	active ingredient
AIHA	American Industrial Hygiene Association
alc.	alcohol
Am., Amer.	American
amts.	amounts
anhyd.	anhydrous
ANSI	American National Standards Institute
AOC	assimilable organic carbon
APHA	American Public Health Association
API	Active Pharmceutical Ingredients
applic(s).	application(s)
aq.	aqueous
AS	acrylonitrile-butadiene-styrene
ASA	acrylic-styrene-acrylonitrile
ASBC	Am. Society of Brewing Chemists
ASTM	American Society for Testing and Materials
ATH	alumina trihydrate
atm	atmosphere
at.wt.	atomic weight
autoignit.	autoignition
aux(s).	auxiliary, auxililaries
avail.	available
avg.	average
a.w.	atomic weight
BAC	biological activated carbon
BATF	Bureau of Alcohol, Tobacco, and Firearms (U.S.)
BDG	butyl diglycol
BDOC	biodegradable dissolved organic carbon
BfArM	Bundesinstitut für Arzneimittel und Medizinprodukte (Federal Institute for Drugs and Medical Devices, Germany)
BGA	Federal Republic of Germany Health Dept. certification
BgVV	Bundesinsititut für Gesundheitlichen Verbraucherschutz und Veterinärmedizin (Federal Institute for Consumer Health Protection and Veterinary Medicine) (Germany)
BHA	butylated hydroxyanisole
BHT	butylated hydroxytoluene
biochem.	biochemical
biodeg.	biodegradable
bldg.	building
blk.	black
BMC	bulk molding compound
BOD	biochemical oxygen demand
BP	British Pharmacopeia
b.p.	boiling point
BR	butadiene rubbers, polybutadienes
B&R	Ball & Ring
br., brn.	brown
brnsh.	brownish
BS	British Standards
B/S	butadiene/styrene
BSI	British Standards Institute
BSS	British Standard Sieve
Btu	British thermal unit
B.U.	Brabender units (viscosity)
BVC	British Veterinary Codex
BVO	brominated vegetable oil
byprod.	byproduct(s)
C	degrees Centigrade
CAA	Clean Air Act
CAB	cellulose acetate butyrate
calcd.	calculated
cap.	capillary
CAS	Chemical Abstracts Service
CC	closed cup
cc	cubic centimeter(s)
CCFAC	Codex Committee on Food Additives and Contaminants
CCl_4	carbon tetrachloride
CD	completely denatured
CDA	completely denatured alcohol
CEL	corporate exposure limit
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act (U.S.)
CFC	chlorofluorocarbon
CFN	Council on Food & Nutrition (Am. Medical Assoc.)
CFR	Code of Federal Regulations (U.S.)
cfu	colony-forming units
cGMP	current good manufacturing practice (U.S. FDA)
ch.	Chapter
char.	characteristic, characterized
chel.	chelation
chem(s).	chemical(s)
CI	Color Index
CIIR	chlorobutyl rubber
CIR	Cosmetic Ingredient Review
cks	centistoke(s)
cl	clear
CL	ceiling concentration
cm	centimeter(s)
cm^3	cubic centimeter(s)
CMC	carboxymethylcellulose
CMC	critical Micelle concentration
c.m.p.	capillary melting point
CNS	central nervous system
CO	carbon monoxide
COC	Cleveland Open Cup
COD	chemical oxygen demand
coeff.	coefficient
COF	coefficient of friction
compat.	compatible
compd(s).	compound(s)
compr.	compression
conc(s).	concentrated, concentration(s)
conduct.	Conductive, conductivity
const.	constant
contg.	containing
cosolv.	cosolvent
CP	Canadian Pharmacopeia
cp	centipoise(s)
CPE	chlorinated polyethylene
cps	centipoise(s)
CPVC	chlorinated polyvinyl chloride
CR	chloroprene rubber, polychloroprene
cryst.	crystalline, crystallization

cs	centistoke(s)
cSt	centistoke(s)
CTFA	Cosmetic, Toiletry and Fragrance Association
ctks	centistoke(s)
CWA	Clean Water Act
cwt	hundred weight
DAB	Deutsche. Arzneibuch (German Pharmacopoeia)
DAC	Deutscher Arneimittel Codex (German Pharmacopoeia Codex)
D&C	Drugs & Cosmetics
dc	direct current
DE	dextrose equivalent
DEA	diethanolamide, diethanolamine
dec.	decomposes
decomp.	decomposition
DEG	diethylene glycol
deliq.	deliquescent
dens.	density
deriv(s).	derivative(s)
descrip.	description
dg	decigram(s)
DI	deionized
diam.	diameter
dielec.	dielectric
dil.	dilute
DIN	Deutsches Institut fuer Normung (German Standards Organization)
disp.	dispersible, dispersion
dissip.	dissipation
dist.	distilled
distort.	distortion
distrib.	distributor
dk.	dark
DMF	dimethyl formamide
DMF	Drug Master Files
DO	dissolved oxygen
D.O.	dissolved oxygen
DOC	dissolved organic carbon
DOM	dissolved organic matter
DOP	dioctyl phthalate
DOT	Department of Transportation (U.S.)
DPG	diphenyl guanidine, dipropylene glycol
DSB	dry solids basis
DSI	Canadian Provisional Domestic Substance list
DTUL	deflection temperature under load
DVB	divinylbenzene
DW	distilled water, deionized water
DWV	drainage, waste and vent
eb, EB	electron beam
EC	European Community
EC50	environmental concentration, 50%
EDTA	ethylenediamine tetraacetic acid
EE	epoxy equivalent
EEC	European Economic Community
EED	environmental endocrine disrupter
EEW	epoxide equivalent weight
e.g.	for example
EGC	Epoxide Group Content
EINECS	European Inventory of Existing Commercial Chemical Substances
elec.	electrical
ELINCS	European List of Notified Chemical Substances
elong.	elongation
EMI	electromagnetic interference
EMS	electromagnetic shielding
ENB	5-ethylidene-2-norbornene
EO	ethylene oxide
EP	European Pharmacopoeia
EP	extreme pressure
EPA	Environmental Protection Agency (U.S.)
EPDM	ethylene-propylene-diene rubber, ethylene-propylene terpolymer
EPR	ethylene-propylene rubber
EPS	expandable polystyrene
equip.	equipment
equiv.	equivalent
ESCR	environmental stress crack resistance
ESD	electrostatic discharge
ESO	epoxidized soybean oil
ESP	electrostatic protection
esp.	especially
EU	European Union
Eur.Ph.	European Pharmacopeia
EVA	ethylene vinyl acetate
evap.	Evaporation
exc.	excellent
F	degrees Fahrenheit
FA	fatty acid
FAO	Food and Agriculture Organization (United Nations)
FAP	Food Additive Petition (U.S.)
FCC	Food Chemicals Codex
FCC	fluorochlorocarbon
FDA	Food and Drug Administration (U.S.)
FD&C	Foods, Drugs, and Cosmetics
FEMA	Flavor and Extract Manufacturers' Association (U.S.)
FEP	fluorinated ethylene propylene
FFA	free fatty acid
FFDCA	Federal Food, Drug, and Cosmetic Act
FG	food grade
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act (U.S. EPA)
FKM	fluoroelastomer
fl	fluid
flamm.	flammable, flammability
flex.	flexural
FNB	Food and Nutrition Board
f.p.	freezing point
FP	French Pharmacopoeia
FR	flame retardant
FR-ABS	flame retardant ABS
FRP	fiberglass-reinforced plastics
F-T	Fischer-Tropsch
ft	foot, feet
f.w.	formula weight
G	giga
g	gram(s)
gal	gallon(s)
g/d	gram/dyne
GFRP	glass fiber-reinforced plastic
G-H	Gardner-Holdt
GI	gastro-intestinal
glac.	glacial
GLP	good laboratory practice
GLY	glycine
GMP	good manufacturing practice
gpd	gallons per day
gpm	gallons per minute
GPPS	general purpose polystyrene
gpt	gallons per ton
gr.	gravity
gran.	granules, granular
GRAS	generally regarded as safe
grn(sh).	green. greenish
GRP	glass-reinforced plastics, glass-reinforced polyester
GVS	Gardner varnish scale (color)
GWP	Global warming potential
h	hour(s)
HAF	high abrasion furnace carbon black
HALS	hindered amine light stabilizer
HAP	hazardous air pollutant
HAPS	hazardous air pollutants
HAP's	hazardous air pollutants
HB	horizontal burning
HC	hydrocarbon

HCFC	hydrochlorofluorocarbon
HCl	hydrochloride, hydrochloric acid
HDPE	high-density polyethylene
HDT	heat distortion (deflection) temp.
HFC	hydrofluorocarbon
Hg	mercury
HIPS	high-impact polystyrene
HLB	hydrophilic lipophilic balance
HMIS	Hazardous Material Identification System
hr	hour(s)
HTST	high temperature short-time pasteurization
HEUR	hydrophobically modified ethoxylate urethane
HVAC	heating, ventilation, air conditioning
HVP	hydrolyzed vegetable protein
hyd.	hydroxyl
hydrog.	hydrogenated
Hz	hertz
IARC	International Agency for Research on Cancer (United Nations)
i.b.p.	initial boiling point
IDLH	immediately dangerous to life and health
I&I	industrial and institutional
IIR	isobutylene-isoprene rubber
IM	intramuscular
immisc.	immiscible
IMP	inosine monophosphate
in.	inch(es)
Inc.	Incorporated
inc.	increases, increased
INCI	International Nomenclature Cosmetic Ingredient
incl.	including
incompat.	incompatible
incorp.	Incorporated, incorporation
indent.	indentation
ing.	ingestion
ingred(s).	ingredient(s)
inh.	inhalation
inj.	injection
inorg.	inorganic
INS	International Numbering System for Food Additives
insol.	insoluble
Int'l.	International
IOFI	International Organization of the Flavor Industry
IP	intraperitoneal
IPA	isopropyl alcohol
IPM	isopropyl myristate
IPP	isopropyl palmitate
IR	isoprene rubber (synthetic), polyisoprene
irreg.	irregular
IU	International Unit
IV	intravenous
J	joule
JCIC	Japanese Cosmetic Ingredients Codex
JCID	Japanese Cosmetic Ingredients Dictionary
JECFA	Joint Expert Committee on Food Additives
JP	Japanese Pharmacopoeia
JSCI	Japanese Standard of Cosmetic Ingredients
JSFA	Japan Standards for Food Additives
k	kilo
KB	Kauri-Butanol
kg	kilogram(s)
KTPP	potassium tripolyphosphate
KU	Krebs units
l	liter(s)
LAB	linear alkylbenzene
LAS	linear alkylbenzene sulfonate
LAO	linear alpha olefins
lb	pound(s)
LC50	lethal concentration 50%
LCLo	lethal concentration low
LD0	lethal dose 0%
LD50	lethal dose 50%
LDLo	lowest published lethal dose
LDPE	low-density polyethylene
LED	light-emitting diode
lel	lower explosive level
lg.	large
liq.	liquid
LLDPE	linear low-density polyethylene
LMDPE	linear medium-density polyethylene
LOEL	lowest observed effect level
lt.	light
Ltd.	Limited
LVP	low vapor pressure
M	mega
M	mole
m	milli
m	meter(s)
m-	meta
manuf.	manufacturer
max.	maximum
mbar	millibar
MCF	methyl chloroform
MCL	maximum contaminant level
MCT	medium chain triglycerides
MD	machine direction, mold direction
MEA	monoethanolamine, monoethanolamide
mech.	mechanial
med.	medium
MEK	methyl ethyl ketone
mfg.	manufacture
mg	milligram(s)
mgd	million gallons/day
MIBK	methyl isobutyl ketone
microcryst.	microcrystalline
microgran.	microgranules, microgranular
MID	Meat Inspection Division (USDA)
MIL	Military Specifications
mil	0.001 inch
min	minute(s)
min.	mineral
min.	minimum
MIPA	monoisopropanolamine, monoisopropanolamide
misc.	miscible, miscellaneous
MITI	Japanese Inventory of Chemical Substances (list)
mixt(s).	mixture(s)
ml	milliliter(s)
MLD	minimum lethal dose
mm	millimeter(s)
MMAP	modified mixed aniline point
MMW-HDPE	medium molecular weight high density polyethylene
mN	millinewton(s)
mo, mos	month(s)
mod.	moderately
mod.	modulus
monocl.	monoclinic
m.p.	melting point
mPa·s	millipascal-second(s)
mppcf	million particles per cubic foot
MRL	maximum residual limits
MSDS	Material Safety Data Sheet
MT	medium thermal
mus	mouse
MVTR	moisture vapor transmission rate
m.w.	molecular weight
N	normal
nat.	natural
NB	nonbreaking
N/B	nitrile-butadiene
NBR	nitrile rubber, nitrile-butadiene rubber
NC	nitrocellulose
NCI	National Cancer Institute
need.	needles
neg.	negative

neut.	neutral, neutralized
NF	National Formulary
NFPA	National Fire Protection Association
ng	nanogram
NIOSH	National Institute for Occupational Safety and Health (U.S.)
nm	nanometer
no.	number
N_2O	nitrous oxide
NO_x	nitrogen oxides
NOEL	no observed effect level
NOI	not otherwise indexed (U.S. DOT)
nonalc.	nonalcoholic
nonaq.	nonaqueous
nonbiodeg.	nonbiodegradable
nonflamm.	nonflammable
nonyel.	nonyellowing
N.O.S.	not otherwise specified (transport regulations)
NPRI	National Pollutant Release Inventory (Canada)
NR	natural rubber, isoprene rubber (natural)
NSF	National Sanitation Foundation, National Standards Foundation
NTP	National Toxicology Program (U.S.)
NV	nonvolatiles
o-	ortho
OBPA	oxybisphenoxarsine
OC	open cup
ODC	ozone-depleting compound
ODP	ozone-depletion potential
OEL	occupational exposure limit
OEM	original equipment manufacturer
OMS	odorless mineral spirits
org.	organic
orig.	original
OSHA	Occupational Safety and Health Administration (U.S.)
OTC	over-the-counter
o/w	oil-in-water
oz	ounce
p-	para
Pa	Pascal
PBT	polybutylene terephthalate
pbw	parts by weight
PC	polycarbonate
PCB	polychlorinated biphenyl
pcf	pounds per cubic foot
PCMX	p-chloro-m-xylenol
PCP	Pest Control Product Act, 1972 (Canada)
PCTFE	polychlorotrifluoroethylene
PDIS	primary dermal irritation score
PE	polyethylene
PEEK	polyetheretherketone
PEG	polyethylene glycol
PEIS	primary eye irritation score
PEK	polyetherketone
PEL	permissible exposure level
perc	perchloroethylene
percut.	percutaneous
PES	polyether sulfone
PET	polyethylene terephthalate
petrol.	petroleum
PFPE	perfluoropolyether
PG	propylene glycol
pH	hydrogen-ion concentration
Ph.	Pharmacopoeia
Ph.Eur.	European Pharmacopoeia
PHA	phosphonohyroxyacetic acid
pharm.	pharmaceutical
Ph.Eur.	European Pharmacopoeia
phr	parts per hundred of rubber or resin
PIB	polyisobutylene
PIN	product identification number
PIR	polyisocyanurate
Pk	peak concentration
pkg.	packaging
PM, P-M	Pensky-Martens
PMCC	Pensky-Martens closed cup
PMMA	polymethyl methacrylate
PMOC	Pensky-Martens open cup
PO	propylene oxide
POC	particulate organic carbon
POE	polyoxyethylene, polyoxyethylated
polyunsat.	polyunsaturated
PoM	prescription-only medicine
POM	polyoxymethylene
POP	polyoxypropylene, polyoxypropylated
POP's	persistant organic pollutants
powd.	powder
PP	polypropylene
ppb	parts per billion
PPE	polyphenylene ether
PPG	polypropylene glycol
pph	parts per hundred (percent)
ppm	parts per million
PPO	polyphenylene oxide
PPS	polyphenylene sulfide
ppt	parts per trillion
pract.	practically
prep(s).	preparation(s)
prod.	product(s), production
props.	properties
PS	polystyrene
ps	poise
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gauge
pt.	point
Pt-Co	platinum-cobalt
PTFE	polytetrafluoroethylene
PTMEG	polytetramethylene ether glycol
PU	polyurethane
PUF	polyurethane foam
PUR	polyurethane
PVA	polyvinyl alcohol
PVAc	polyvinyl acetate
PVAL	polyvinyl alcohol
PVB	polyvinyl butyral
PVC	polyvinyl chloride
PVC-P	plasticized polyvinyl chloride
PVC-U	unplasticized polyvinyl chloride
PVDC, PVdC	polyvinylidene chloride
PVDF	polyvinylidene fluoride
PVM	polyvinyl methyl ether
PVM/MA	polyvinyl methyl ether/maleic anhydride
PVP	polyvinylpyrrolidone
PWB	partial weight bearing
qt	quart
quat.	quaternary
R&B	Ring & Ball
rbt	rabbit
RCRA	Resource Conservation and Recovery Act (U.S. EPA 40CFR §261)
R&D	research and development
RDA	recommended daily allowances
rdsh.	reddish
rec.	recommended
ref.	refractive
reg.	registry
regs.	regulations
REL	recommended exposure limit
rep.	represents
resist.	resistance, resistant, resistivity
resp.	respectively
RFI	radio frequency interference
r.h.	relative humidity

rhomb.	rhombic
RIM	reaction injection molded/molding
RO	reverse osmosis
rpm	revolutions per minute
RQ	reportable quantity
R.T.	room temperature
RTECS	Registry of Toxic Effects of Chemical Substances (U.S.)
RTM	resin transfer molding
RTV	room temperature vulcanizing
RV	recreational vehicle
s	second(s)
s-	secondary
SADT	self accelerating decomposition temp.
SAN	styrene-acrylonitrile
sapon.	saponification
SARA	Superfund Amendments & Reauthorization Act (U.S.)
sat.	saturated
S/B	styrene/butadiene
SBR	styrene/butadiene rubber
SBS	styrene-butadiene-styrene
SD	specially denatured
SDA	specially denatured alcohol
SE	self-emulsifying
SEBS	styrene-ethylene/butylene-styrene
sec.	secondary
semicryst.	semicrystalline
semiliq.	semiliquid
semisyn.	semisynthetic
sl.	slight, slightly
sm.	small
SMA	styrene maleic anhydride
SMC	sheet molding compound
SMG	succinylated monoglycerides
SNAP	Significant New Alternative Policy (U.S. EPA)
soften.	softening
sol.	soluble, solubility
solid.	solidification
sol'n.	solution
solv(s).	solvent(s)
sp.	specific
spec.	specification, specialty
SPF	sun protection factor
spp.	non-specified species
SRF	semireiniforced furnace
SS	stainless steel
SSU	Saybolt Universal Seconds
std.	standard
STEL	short term exposure limit
Stod.	Stoddard solvent
STP	standard temperature and pressure
str.	strength
subcut.	subcutaneous
subl.	sublimes
surf.	surface
SUS	Saybolt Universal Seconds
susp.	suspension
syn.	synthetic
t	tertiary
TAPPI	Technical Association of the Pulp & Paper Industry
TBHQ	tert-butyl hydroquinone
TCC	Tag closed cup
TCLo	toxic concentration low
TDI	toluene diisocyanate
TDLo	toxic dose low
TDS	total dissolved solids
TEA	triethanolamine, triethanolamide
tech.	technical
temp.	temperature
tens.	tensile, tension
tert	tertiary
THF	tetrahydrofuran
THMs	trihalomethanes
TIPA	triisopropanolamine
TKPP	tetrapotassium pyrophosphate
TLV	Threshold Limit Value
TLV-CL	Threshold Limit Value/ceiling limit
TLV-STEL	Threshold Limit Value/short therm exposure limit
TLV-TWA	Threshold Limit Value/time weighted average
TMC	thick molding compound
TOC	Tag open cup, total organic carbon
tox.	toxicity
TPE	thermoplastic elastomer
TPU	thermoplastic polyurethane
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
tsp	teaspoon
TSS	total suspended solids
TWA	time weighted average
TWC	time weighted concentration
typ.	typical
uel	upper explosive limits
UF	urea formaldehyde
UF	ultra filtration
UHF	ultra high frequency
UHMW	ultra high molecular weight
UHMWPE	ultra high molecular weight polyethylene
UHT	ultra high temperature
UL	Underwriter's Laboratory
UN No.	United Nations Substance Identification Number (for transport purposes)
unsat.	unsaturated
UPVC	unplasticized polyvinyl chloride
USDA	U.S. Department of Agriculture
USFA	United States Food Additives
USP	United States Pharmacopeia
uv, UV	ultraviolet
V	volt
VA	vinyl acetate
VAE	vinyl acetate ethylene
VC	vinyl chloride
VCA	vinyl chloride-acrylic
VdC, VDC	vinylidene chloride
veg(s).	vegetable, vegetables
visc.	viscous, viscosity
VM&P	Varnish Makers and Painters
VOC	volatile organic compounds
vol.	volume
v/v	volume by volume
wh.	white
WEEL	Workplace Environmental Exposure Level (U.S.)
WFC	World Food Council
WHMIS	Workplace Hazardous Materials Information System (Canada)
WHO	World Health Organization (United Nations)
wks	weeks
w/o	water-in-oil
wt.	weight
w/v	weight by volume
w/w	weight by weight
XLPE	crosslinked polyethylene
X-PE	crosslinked polyethylene
yel.	yellow
ylsh.	yellowish
yr	year
#	number
%	percent
<	less than
>	greater than
≤	less than or equal to
±	plus or minus
≥	greater than or equal to
@	at
α	alpha
β	beta

δ,Δ	delta
ε	epsilon
γ	gamma
Ω	omega

µ	micron, micrometer
µg	microgram
$\approx$	approximately equal to

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Part II
Chemical Component Cross-Reference

A

AA. *See* Acrylic acid
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ABFA. *See* Azodicarbonamide
Abietic acid sodium salt. *See* Sodium rosinate
ABS. *See* Dodecylbenzenesulfonic acid
Absolute alcohol; Absolute ethanol. *See* Alcohol

Acacia
CAS 9000-01-5; EINECS/ELINCS 232-519-5
FEMA 2001; INS414; E414
Synonyms: Acacia farnesiana; Acacia gum; Acacia senegal; Acacia syrup; Arabic gum; Australian gum; Gum Arabic; Gum hashab; Gum ovaline; Gum senegal; Indian gum; Kordofan gum; Senegal gum; Sudan gum
Classification: Water-sol. gum
Definition: Dried gummy exudate from stems and branches of *Acacia farnesiana* or *A. senegal*
Properties: Ylsh.-wh. angular fragments, odorless; sol. in water; insol. in alcohol; m.w. 240,000
Toxicology: LD50 (oral, rat) 18 g/kg; very low toxicity by ing.; inh. or ing. may produce hives, eczema, angioedema, asthma; allergic responses; people prone to allergies should avoid acacia; severe eye irritant; experimental reproductive effects; mutation data; TSCA listed
Precaution: Combustible
Hazardous Decomp. Prods.: Heated to decomp., emits acrid smoke
Uses: Emulsifier, stabilizer, thickener in pharmaceuticals, adhesives, inks, textile printing, cosmetics, foods; flotation depressant; protective colloid; mfg. of spray-dried flavors; lithographic reagent; lubricant; emollient; thickener, stabilizer for soft drinks, cake mixes, confectionery; tablet binder/disintegrant/excipient; gellant in medicated cough drops; film-former for coated pills; encapsulation for liposol. vitamins; suspending agent in syrups
Regulatory: FDA 21CFR §169.179, 169.182, 172.230, 172.510, 184.1330, GRAS; FEMA GRAS; Japan approved; Europe listed; UK approved; ADI not specified (JECFA); NF, EP, BP compliance
Manuf./Distrib.: AAA Int'l.; AB R Lundberg; AEP Colloids; Agrisales Ltd; Aldrich; Alfa Chem; Alfred L. Wolff Inc; Alland & Robert; Arthur Branwell; Ashland; Atomergic Chemetals; Aventis Pharmaceuticals; Barrington; Bio-Botanica; Brenntag Southeast; CarboMer; Chart; ChemTech Specialties; Chemacon GmbH; Chr. Hansen Inc; Colloides Naturels Int'l.; Cornelius Chem. Co. Ltd; Degussa AG/Health & Nutrition; Delta Distributors; EM Chemicals; EMD Chems.; Eggar & Co.; Fluka; Frutarom Ltd; Frutarom; Functional Foods; Galbraith Labs; Gallard-Schlesinger Ind.; Gumix Int'l.; Houghton Chem.; Ikeda; Importers Service; Integra; J.T. Baker; KIC Chems.; Lebermuth; Liberty Natural Prods.; Lucid Colloids; MPSI; Merck KGaA; Mutchler; NB Entrepreneurs; P.B. & S.; P.L. Thomas; Pangaea Sciences; Penta Mfg.; Polysciences; PureWorld Botanicals; Quest Int'l.; RIA Int'l.; Rhodia; Robeco; Ruger; Sarcom; Sigma; Spectrum Quality Prods.; Spice King; TIC Gums; Thew Arnott & Co. Ltd; Tiger Chem.; Univar E&E Ltd; Universal Preserv-A-Chem; V.L. Clark; VWR Int'l.; Voigt Global Distrib.; Vopak USA; Zumbro
Trade Names: Granular Gum Arabic Type A-1 NF Premium; Granular Gum Arabic Type A-2 NF Premium; Gum Arabic NF/FCC Clean Amber Sorts; Insta*Thick® Gum Arabic; Nutriloid® Gum Arabic; Powdered Gum Arabic Type B-100 NF Premium; Powdered Gum Arabic Type B-200 NF Premium; Premium Granular Gum Arabic; Premium Powdered Gum Arabic; Premium Spray Dried Gum Arabic; Spray Dried Gum Arabic Type A-180 NF Premium; Spray Dried Gum Arabic Type A-230 NF Extra; Spray Dried Nigerian Gum Arabic; TIC Pretested® Arabic PH SD; TIC Pretested® Gum Arabic #1 Powd.; TIC Pretested® Gum Arabic 6/60 FCC Gran.; TIC Pretested® Gum Arabic BEV-101 GR Powd.; TIC Pretested® Gum Arabic BEV-202 Powd.; TIC Pretested® Gum Arabic Extra Special Powd.; TIC Pretested® Gum Arabic FT-1 Powd.; TIC Pretested® Gum Arabic FT Powd.; TIC Pretested® Gum Arabic FT Pre-Hydrated®; TIC Pretested® Gum Arabic Spray Dry FCC Powd.; TIC Pretested® Gum Arabic Spray Dry NF/USP Powd.; TIC Pretested® Pre-Hydrated® Gum Arabic FT Powd.; TIC Pretested® Pre-Hydrated® Gum Arabic Spray Dry FCC Powd.
Trade Names Containing: Merecol® FAL; TIC Pretested® Aragum® T-1998 Powd.

Acacia farnesiana
CAS 9001-01-5; EINECS/ELINCS 232-519-5
Synonyms: Acacia farnesiana gum; Gum Arabic
Definition: Plant material derived from dried, gummy exudate of *Acacia farnesiana*
Toxicology: TSCA listed
Uses: Emulsifier in beverages, gelatins, puddings, fillings, snack foods, soft candy; flavoring agent in chewing gum, hard candy, cough drops; formulation aid in confections, frostings, fats and oils, nuts, frozen confections; visc. control agent, astringent in cosmetics
Regulatory: FDA 21CFR §169.172, 169.182, 184.1330

Acacia farnesiana. *See* Acacia
Acacia farnesiana gum. *See* Acacia farnesiana
Acacia gum. *See* Acacia

Acacia senegal
CAS 9000-01-5; EINECS/ELINCS 232-519-5
Synonyms: Gum Arabic
Definition: Plant material derived from the dried, gummy exudate of *Acacia senegal*
Uses: Emulsifier in beverages, gelatins, puddings, fillings, snack foods, soft candy; flavoring agent in chewing gum, hard candy, cough drops; formulation aid in confections, frostings, fats and oils, nuts, frozen confections; visc. control agent in cosmetics
Regulatory: FDA 21CFR §169.179, 169.182, 184.1330; Canada DSL

Acacia senegal; Acacia syrup. *See* Acacia
Aceite de Algodon. *See* Cottonseed (Gossypium) oil
Aceite de ricino. *See* Castor (Ricinus communis) oil

Acetaldehyde
CAS 75-07-0; EINECS/ELINCS 200-836-8
UN 1089 (DOT); FEMA 2003
Synonyms: Acetic aldehyde; Ethanal; Ethyl aldehyde
Classification: Aldehyde
Empirical: C_2H_4O
Formula: CH_3CHO
Properties: Colorless fuming liq. or gas; pungent fruity odor; misc. in water, alcohol, ether, oxygenated and aromatic solvs.; m.w. 44.06; dens. 0.788 (16/4 C); m.p. -123.5 C; b.p. 20.8 C; flash pt. (CC) -38 C; ref. index 1.3316 (20 C)
Toxicology: ACGIH TLV/TWA 100 ppm; STEL 150 ppm; LD50 (oral, rat) 1930 mg/kg, (subcut., rat) 640 mg/kg, (skin, rabbit) 3540 mg/kg; poison by intratracheal/IV routes; human systemic irritant by inh.; narcotic; lachrymator; irritating to eyes, respiratory system; confirmed carcinogen; human mutagenic data; experimental tumorigen, teratogen; skin and severe eye irritant; TSCA listed
Precaution: Flamm. liq. (DOT); can react violently with acid anhydrides, alcohols, ketones, phenols, NH_3, halogens, etc.; reaction with oxygen may lead to detonation; common air contaminant
Hazardous Decomp. Prods.: Heated to decomp., emits acrid smoke and fumes
NFPA: Health 3, Flammability 4, Reactivity 2
Storage: Air-sensitive; store below 4 C
Uses: Mfg. of acetic acid, acetic anhydride, n-butanol, peracetic acid, pentaerythritol, pyridines, 1,3-butylene glycol, trimethylolpropane; intermediate for paints; synthetic flavoring agent in foods, beverages, pharmaceuticals; nail conditioner in cosmetics; mfg. of pharmaceuticals, pesticides, dyestuffs; in food-contact phenolic molding resins
Regulatory: FDA 21CFR §177.2410, 182.60, 27CFR §21.93, GRAS; FEMA GRAS; HAP; Canada DSL
Manuf./Distrib.: Acros Org.; Advanced BioTech; Aldrich; Alfa Aesar; Allchem Ind.; Augustus Oils Ltd; Axxence Aromatic GmbH; BP Chemicals; Celanese; Chem-Supply; Degussa Flavors/ALEX FRIES; Eastman; Fleurchem; Fluka; Frutarom Ltd; Givaudan Fragrances; Integra; J.T. Baker; Lluch Essence; Lonza; Oxford Chems. Ltd; Penta Mfg.; Sigma; Spectrum Quality Prods.; Total Spec. Chems.; Triple Crown Am.; VWR Int'l.; Wacker-Chemie GmbH
Trade Names Containing: Igepal® OD-410

Acetamide
CAS 60-35-5; EINECS/ELINCS 200-473-5
Synonyms: Acetic acid amide; Acetic acid amine; Acetimidic acid; Ethanamide; Ethanolamide; Methanecarboxamide
Classification: Nonaromatic amide
Empirical: C_2H_5NO

Formula: CH_3CONH_2
Properties: Wh. cryst.; odorless when pure, but frequently has mousy odor; sol. in water, alcohol, chloroform, glycerol, hot benzene; m.w. 59.07; dens. 1.159; vapor pressure negligible; m.p. 82 C; b.p. 221 C; ref. index 1.4274; neutral reaction
Toxicology: LD50 (oral, rat) 7 g/kg, (IP, rat) 10,300 mg/kg, (IV, rat) 12,500 mg/kg, (subcut., rat) 10 g/kg; eye/skin/respiratory tract irritant; may cause sleep disturbances, muscle weakness, dyspnea, spastic paralysis, lacrimation, change in heart rate; cancer suspect agent; tumorigen; reproductive effector; mutagen; target organ: liver; TSCA listed
Precaution: Incompat. with strong oxidizers, metals, halogenated materials; avoid ignition sources, excess heat, elec. sparks
Hazardous Decomp. Prods.: CO, CO_2, NO_x
Storage: Hygroscopic, deliq.; store under nitrogen in cool, dry, well-ventilated area away from incompat. substances
Uses: Solubilizer; solvent for many org. and inorg. compds., plastic films; dye solvent, dye assistant for textiles; mfg. of methylamine; denaturing alcohol; in organic synthesis; drug intermediate in mfg. of ampicillin, cephaclor, etc.; solder flux ingred.; plasticizer in leather, cloth films, coatings; stabilizer; humectant in paper; accelerator; buffer in lacquers, explosives, cosmetics; prep. of hypnotics; photochemicals; biocides; cryoscopy; vehicle in pharmaceuticals; antidote
Regulatory: HAP; Canada DSL
Manuf./Distrib.: Aldrich; Alfa Aesar; Chem-Supply; Fallek; Fluka; Global-Seven; Heico; Integra; J.T. Baker; McIntyre; Otira Pharmaceuticals; Penta Mfg.; Sigma; Spectrum Quality Prods.; Universal Preserv-A-Chem; VWR Int'l.

Acetamide MEA
CAS 142-26-7; EINECS/ELINCS 205-530-8
Synonyms: 2-Acetamidoethanol; 2-Acetylaminoethanol; N-Acetyl ethanolamine; N-Ethanolacetamide; Hydroxyethyl acetamide; β-Hydroxyethylacetamide; N-(2-Hydroxyethyl) acetamide; N-β-Hydroxyethylacetamide
Classification: Aliphatic amide
Ionic Nature: Nonionic
Empirical: $C_4H_9NO_2$
Formula: $CH_3CONHCH_2CH_2OH$
Properties: Brn. visc. liq.; misc. with water; m.w. 103.14; dens. 1.12 (20/4 C); f.p. 15.8 C; b.p. 195-196 C; flash pt. (OC) 355 F; dec. on heating
Toxicology: LD50 (oral, rat) 26,950 mg/kg; mildly toxic by ing.; skin and severe eye irritant; TSCA listed
Precaution: Combustible exposed to heat or flame; can react vigorously with oxidizers
Hazardous Decomp. Prods.: Heated to decomp., emits toxic fumes of NO_x
Uses: Solvent; antistat, humectant, thickener in cosmetics; skin and hair conditioner; chemical intermediate; coupling agent; pigment dispersant; clarifier for shampoos; moisturizer; solubilizer, humectant, conditioner, coupling agent, pigment dispersant in topical pharmaceuticals; in food-pkg. adhesives
Regulatory: FDA 21CFR §175.105; Canada DSL
Manuf./Distrib.: AXO Chem.; Aldrich; Global-Seven; McIntyre; Universal Preserv-A-Chem
Trade Names: Foamid AME-70; Foamid AME-75; Foamid AME-100; Hetamide MA; Jeemide MEAA; Lipamide MEAA 75%; Mackamide™ AME-75; Mackamide™ AME-100; Protamide™ MEAA; Schercomid AME-70; Schercomid AME-100
Trade Names Containing: Lipo-Peptide AME 30

2-Acetamidoethanol. *See* Acetamide MEA
Acetate ester, C6 alcohol branched. *See* Oxo-hexyl acetate
1-Acetate-1,2,3-propanetriol. *See* Glyceryl acetate
Acetene. *See* Ethylene

Acetic acid
CAS 64-19-7; EINECS/ELINCS 200-580-7
UN 2789 (DOT); UN 2790 (DOT); FEMA 2006; INS260; E260
Synonyms: Ethanoic acid; Ethyllic acid; Methanecarboxylic acid; Pyroligneus acid; Vinegar acid
Classification: Aliphatic organic acid
Empirical: $C_2H_4O_2$
Formula: CH_3COOH
Properties: Clear colorless liq.; pungent vinegar-like odor; sharply acid taste; misc. with water, alcohol, glycerol, ether; insol. in carbon disulfide; m.w. 60.03; dens. 1.0492 (20/4 C); m.p. 16.63 C; b.p. 118 C (765 mm); visc. 1.22 cps (20 C); vapor pressure 11.4 mm Hg (20 C); flash pt. (OC) 43 C; autoignition temp. 463 C; ref. index 1.3715 (20 C); surf. tens. 27.42 dynes/cm; dielec. const. 61.70
Toxicology: ACGIH TLV/TWA 10 ppm; STEL 15 ppm; LD50 (oral, rat) 3310 mg/kg, (skin, rabbit) 1060 mg/kg; mod. toxic by ingestion, inhalation; corrosive; strong irritant to eyes, skin, and tissue; caustic; can cause burns, lachrymation; human systemic effects by ing.; experimental reproductive effects; mutation data reported; TSCA listed
Environmental: VOC; BOD5 0.65; COD 1.09; ThOD 1.07
Precaution: Flamm.; moderate fire and explosion hazard exposed to heat or flame; can react vigorously with oxidizers; explosive or violent reactions possible; incompat. with many chems.; a common air contaminant
Hazardous Decomp. Prods.: Heated to decomp., emits irritating fumes
NFPA: Health 2, Flammability 3, Reactivity 0
Uses: Mfg. of acetic anhydride, cellulose acetate, vinyl acetate monomer; acetic esters; prod. of plastics, pharmaceuticals, cosmetics, aroma chems., dyes, insecticides, photographic chemicals, food additives; solvent reagent; acidifier; solvent for electronic materials; etchant (semiconductor mfg.); aluminum brightener; laundry sour; boiler water additive; coagulant for latex; buffer in cosmetics; buffer, acidifier in textile baths; preservative, acidity regulator in foods; flavor, solvent, vehicle in foods, pharmaceuticals; color diluent; sanitizing solutions for food contact
Regulatory: FDA 21CFR §73.85, 133.123, 133.124, 133.169, 133.173, 133.178, 133.179, 172.814, 178.1010, 184.1005, GRAS; FEMA GRAS; USDA 9CFR §318.7; CERCLA hazardous substance; Europe listed; UK approved; NF, BP compliance
Manuf./Distrib.: AB R Lundberg; AMC Chems.; AMRESCO; Advanced BioTech; Air Prods.; Aldrich; Alfa Aesar; Alfa Chem; Allchem Ind.; Am. Biorganics; Amyl; Apollo; Arch Chems.; Ashland; Asiamerica Int'l.; Augustus Oils Ltd; Aventis SA; Axxence Aromatic GmbH; BASF; BP Chemicals; BP Chems. Ltd; Brenntag AG; Brenntag Southeast; Brown; Captree; Celanese; ChemTech Specialties; Chemical; Coyne; Daicel Chem. Ind.; Degussa AG/Health & Nutrition; Degussa Flavors/ALEX FRIES; Delta Distributors; DuPont; E&E Ltd; EMD Chems.; Eastman; Elan; Equistar; Fisher Scientific; Fleurchem; Florida Distillers; Fluka; Frutarom Ltd; General Chem.; George Uhe; Harcros; Integra; Jubilant Organosys; J.C. Wilson; J.T. Baker; Keith Harris & Co. Ltd; Lonza Ltd; MPSI; Mallinckrodt Baker; Millennium; Moore Ingreds.; Noveon Diamalt GmbH; Oxford Chems. Ltd; P.B. & S.; PMC Spec.; Penta Mfg.; Pfaltz & Bauer; Prodasynth; Quaker City; Rhodia; Romil Ltd; Ruger; Seeler Ind.; Showa Denko; Siber Hegner Ltd; Sigma; Spectrum Quality Prods.; Sterling Chems.; Thomas Scientific; Triple Crown Am.; Universal Preserv-A-Chem; VWR Int'l.; Varsal Instruments; Veckridge; Vopak USA; Wacker-Chemie GmbH; Xinchem; Zetapharm
Trade Names Containing: Panatex® K; Super Panatex® K

Acetic acid amide; Acetic acid amine. *See* Acetamide
Acetic acid, [2-[2-butoxyethoxy] ethoxy]-. *See* Buteth-2 carboxylic acid
Acetic acid, (2-butoxyethoxy)-, sodium salt. *See* Sodium butoxyethoxy acetate
Acetic acid, 2-butoxyethyl ester. *See* Butoxyethanol acetate
Acetic acid, butyl ester; Acetic acid n-butyl ester. *See* n-Butyl acetate
Acetic acid, C7-9-branched alkyl esters, C8-rich. *See* C8 alkyl acetate
Acetic acid, cobalt (2+) salt. *See* Cobalt diacetate
Acetic acid, cobalt (2+) salt, tetrahydrate. *See* Cobalt acetate (ous)
Acetic acid, decyl ester, branched. *See* C10 alkyl acetate
Acetic acid, esters with lanolin alcohols. *See* Acetylated lanolin alcohol
Acetic acid esters of mono- and diglycerides; Acetic acid esters of mono- and diglycerides of fatty acids. *See* Acetylated mono- and diglycerides of fatty acids
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Acetic acid, ethenyl ester, polymer with ethene. *See* Ethylene/VA copolymer
Acetic acid ethenyl ester, polymer with ethenol. *See* Polyvinyl alcohol (partially hydrolyzed)
Acetic acid ethenyl ester, polymer with 1-ethenyl-2-pyrrolidonone. *See* PVP/VA copolymer
Acetic acid, (ethylenedinitrilo) tetra-, tetrasodium salt. *See* Tetrasodium EDTA
Acetic acid, ethyl ester. *See* Ethyl acetate
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Acetic acid, 2-methoxy-1-methylethyl ester. *See* Propylene glycol methyl ether acetate
Acetic acid, 2-methoxypropyl ester. *See* 2-Methoxy-1-propanol acetate
Acetic acid, monoglyceride. *See* Glyceryl acetate
Acetic acid sodium salt anhydrous. *See* Sodium acetate anhydrous
Acetic acid, sorbitol ester. *See* Sorbityl acetate
Acetic acid, sulfo-, 1-dodecyl ester, sodium salt; Acetic acid, sulfo-, dodecyl ester, S-sodium salt. *See* Sodium lauryl sulfoacetate
Acetic acid, vinyl ester, polymer; Acetic acid vinyl ester polymers. *See* Polyvinyl acetate
Acetic aldehyde. *See* Acetaldehyde
Acetic ester; Acetic ether. *See* Ethyl acetate
Acetic, 1,2,3-propanetriyl ester. *See* Triacetin
Acetimidic acid. *See* Acetamide
Acetin. *See* Glyceryl acetate; Triacetin
Acetodiphosphonic acid. *See* Etidronic acid
Acetoglycerides. *See* Acetylated mono- and diglycerides of fatty acids

Acetone
CAS 67-64-1; EINECS/ELINCS 200-662-2
UN 1090 (DOT); UN 1091 (DOT); FEMA 3326
Synonyms: Acetone oils; Dimethyl formaldehyde; Dimethylketal; Dimethylketone; DMK; Ketone, dimethyl; Ketone propane; β-Ketopropane; Methyl ketone; Propanone; 2-Propanone; Pyroacetic acid; Pyroacetic ether