#### а

acid mantle 275, 295 active ingredient 121 active substance groups 291-292 activity coefficients 140 additives 290-291 adhesion force 32-33 aerosil silica 89 airless dispenser 289, 307, 309-310 aluminophosphates (AlPOs) 193-198 amphilic creams 51 amplitude dependence 65-66 anisotropic particles 23 apparent shear stress 14, 17, 61 apparent yield stress 8, 59 aqueous clay gels 87-89 - organo-clays (bentones) 76-89 aqueous continuous phase 318-319 aqueous polystyrene latex model suspensions 100 Arrhenius equation 96 associative thickeners 75, 82-86 atom connectivity indices 148 atom interaction parameters (AIPs) 148 attractive particles 19, 28-36 average droplet diameter 116

### b

Bancroft rule 280 barley 230 BASIL process 179–180 Batchelor equation 18 bean 234–235 beautifications cosmetic products 276–277 bentones, *See* organo-clays (bentones) benzyl esters 289 binary mixtures, of ionic liquids 182–183, 189–191 physicochemical properties 183–186
potential applications 188–189
structural investigations 186–188
biological product design 1
biological value (BV) 257
bread and bakery products 262
broad bean 235
Brownian dispersions, *See* colloidal suspensions
bulk modulus 99
butyl ester 289

### С

canola protein 234, 256 capillary forces, in suspension rheology 33 - 34capillary number 41 capillary rheometer 15-16 casein 318-319 catalytic hydrogenation reactions, in ionic liquids 201, 209 - early developments 202-203 - SILCA-type materials 205-208 - stereoselective hydrogenation reactions 203-204 - thermomorphic phases 204-205 cationic surfactants 113 cavity transfer mixers (CTMs) and controlled deformation dynamic mixers (CDDMs) 325 - 326celiac disease 265 Center for Energy Resources Engineering (CERE) 164 centrifuge 97 cereal crop plants gelation - maize/corn 229 - rice proteins 228 - sorghum 229

Product Design and Engineering: Formulation of Gels and Pastes, First Edition. Edited by Ulrich Bröckel, Willi Meier, and Gerhard Wagner. © 2013 Wiley-VCH Verlag GmbH & Co. KGaA. Published 2013 by Wiley-VCH Verlag GmbH & Co. KGaA.

cereal crop plants gelation (contd.) - wheat proteins 227-228 cereal proteins, in gelation 222 chemical product design 1 circumferential velocity 14 cloud point 133 coagel phase 319 coagulation 106 coalescence 55-56, 97, 109, 315, 317, 322-323, 328, 332-335, 337, 339 correlation with elastic modulus 118 - 119 emulsion coalescence assessment and prediction techniques 115-119 - and Ostwald ripening 109 – rate 116 cohesive energy 119 cohesive energy ratio (CER) 135 cold gelation 239-240, 319 colloidal suspensions rheology 16-17 attractive particles 28–36 – hard spheres 17 – non-spherical particles 20–23 - - suspension of spheres viscosity in Newtonian media 17-20 particle size distribution effects 36 - repulsive particles 10-28 - shear thickening 38-40 combination test 59 combined temperature-time test 71-73 complex viscosity 11  $\beta$ -conglycinin 230 concentric cylinder measuring system 12 - 13conductivity 176 cone-and-plate measuring system 14-15 constant stress (creep) experiments 79, 109-110 Cook's kinetic method 187 cosmeceuticals 274, 277, 288, 291-292 - design elements 310 - differences with drugs 278-279 - effects 293 - for healthy skin 277-278 product performance parameters 311 cosmetic emulsions rheology 51-52 chemistry -- emulsifier-free products 53-54 – emulsion production 54–55 -- microemulsions 53 -- modern emulsifiers 52-53 – processes occurring during emulsification 55

– serrated disc disperser 55–56

- - skin care and cleansing 53 - dynamic mechanical tests (oscillation) 65 - - amplitude dependence 65-66 - - combined temperature-time test 71-73 - - frequency test 68 - - structure breakdown and build-up 67 - 68-- temperature dependence 68, 70 - - time dependence 68 measurements -- creep and creep recovery test 62-63 - - ideal elastic behavior 62 -- ideal viscous behavior 62-63 -- Newtonian flow behavior 61 - - real viscoelastic behavior 63 -- stationary flow behavior 56-58 -- steady flow curve 63-65 -- stress ramp test 58-61 Cosmetics Directive annex 290 costructure-directing agents (co-SDAs) 198 - 199Couette mode 13 Coulter Counter 116, 117 cowpea 236-237 Cox-Merz rule 27 cream cheese 330-331 creaming and sedimentation 95-96 - accelerated tests and limitations 96 - correlation examples with residual (zero shear) viscosity - - aqueous polystyrene latex model suspensions 100 - - creep measurements for creaming prediction 104 - - emulsion creaming prediction 102-103 - - non-Newtonian liquids sedimentation 101 - - oscillatory measurements for creaming prediction 104-105 -- thickeners 101-102 - emulsion coalescence assessment and prediction techniques 115-116 -- coalescence rate 116 – – cohesive energy 119 - - correlation between elastic modulus and coalescence 117-119 - - storage modulus measurement as function of time 117-118 -- viscosity measurements 116-117 - - vield value measurement as function of time 117 - flocculation - - and restabilization of clays using cationic surfactants 113

 – of sterically stabilized dispersions 113 - 114 – of sterically stabilized emulsions 114 - 115 flocculation assessment and prediction - - constant stress (creep) experiments 109 - 110- - Derjaguin-Landau-Verwey-Overbeek (DLVO) theory 105-108 - - dynamic (oscillatory) measurements 110 - 112- - Ostwald ripening and coalescence 109 – steady state shear stress-shear rate measurements 109 - - study techniques 108 -- wall slip 108-109 - high gravity force application 96-97 rheological prediction techniques 98 - svneresis 99 creams 51 creep and creep recovery test 62-63 creep measurements, for creaming prediction 104 critical capillary number 326-327 critical compressibility factor 128 critical micelle concentration (CMC) 133 - 134critical packing parameter (CPP) 135 critical shear stress 60 crosslinked gels (chemical gels) 78, 79 crosslinked polymers 76, 78, 80 crosslinking, of proteins 224, 228, 329, See also microbial transglutaminase (MTG) cross-over point 112 cruciferin 234 cycles, for product design optimization 301 cycle test, See combined temperature-time test

## d

dairy cream 331 deamidation 259 Deborah number 79 Debye length 24 Derjaguin–Landau–Verwey–Overbeek (DLVO) theory 24, 105–108 dermal membrane structure (DMS) cream 54 dermatological creams and features 275 dermatological products, legal basis in Europe 279 designer solvents 182, 200

Design Institute for Physical Property Data (DIPPR) database 156, 160 DETHERM 156-158, 162-164 dielectric constant 128-129 dilatancy 95 dimensionless numbers and process functions 326-328 dimensionless shear rate, See Péclet number disperse systems rheology 7-8 - basics 8-11 – colloidal suspensions 16–17 - - attractive particles 28-36 – – hard spheres 17–23 - - particle size distribution effects 36-38 – repulsive particles 10–28 -- shear thickening 38-40 - emulsions 40-46 - experimental methods 12, 15-16 - - capillary rheometer 15-16 - - rotational rheometry 12-15 Dortmund DATABASE (DDB) 156, 159, 164 double logarithmic plot of viscosity versus shear stress 60 droplet aggregation 334 droplet relation time 41 droplet volume fraction 41-42 dynamic (oscillatory) measurements 79, 110 - oscillatory sweep measurements 112 - strain sweep measurements 111-112 dynamic mechanical tests (oscillation) 65-66 - amplitude dependence 65 - combined temperature-time test 71-73 - frequency test 68-69 - structure breakdown and build-up 67-68 - temperature dependence 70-71 - time dependence 68 dynamic viscosity 129, 143, 176-177

## е

effective particle radius 24 Einstein equation 18, 40 elastic modulus 30–31 – and coalescence correlation 118–119 Electrolyte Database Regensburg (ELDAR) 162–164 electrolyte solutions properties and database examples – CERE DTU chemical engineering 164 – closed collections 165 – DDB 164 – DETHERM/ELDAR 162–164 – JESS 164 – Landolt–Börnstein database 165

electrostatic interactions 25, 27

electrosteric stabilization 28 elongated particles 23-24 ELYS database 165 emulsification machines 324-326 emulsified formulated products 132-133 - cloud point 133 – critical micelle concentration (CMC) 133-134 hydrophilic-lipophilic balance (HLB) 134 - 136- Krafft temperature 136 - surface tension 136-137 emulsifier-free products 53-54 emulsion coalescence assessment and prediction techniques 115-116 - coalescence rate 116 - cohesive energy 119 – correlation between elastic modulus and coalescence 118-119 - storage modulus measurement as function of time 117-118 - viscosity measurements 116-117 - vield value measurement, as function of time 117 emulsion formulated products performance properties 142 dedicated models 143–144 - distinct values 142 linear mixing rule 142–143 emulsions 280 application 296 - creaming prediction 102-103 - definition, structure, and classification 280-282 droplet stability 334 preparation in laboratory 285–286 - production 54-55 - rheology 40-46 - stability 282-285 environmental, health, and safety related properties 132 enzymatically textured plant proteins, for food industry 247-249, See also microbial transglutaminase (MTG) ethoxylated fatty alcohols 281 evaporation time 129 excess enthalpy 185 excess molar volume 185 excipients 286-288

# f

fat continuous food products 335–337 Fick's law 300 finely divided oxides 87 fine-strand gels 239 flash point 141–142 flocculation - assessment and prediction techniques - - constant stress (creep) experiments 109 - 110- - dynamic (oscillatory) measurements 110-112 - - Ostwald ripening and coalescence 109 -- steady state shear stress-shear rate measurements 109 - - study techniques 108 -- wall slip 108-109 - bridging 29 - by capillary forces 29 - of charged particles 29 - depletion 29 - and restabilization of clays using cationic surfactants 113 - of sterically stabilized dispersions 113 - 114- of sterically stabilized emulsions 114-115 - of sterically stabilized particles 29 fluidization, of highly concentrated dispersions 35-36 fluorohydrogenate (HF) 181, 193-195 food design and engineering 1 food emulsion gels 315-316 - continuous phase 318 -- aqueous 318-319 - - emulsion stabilization by emulsifiers and particles 320-321 --lipid 319-320 - - structurant hydration in organogel-based emulsions 321 - creation -- basic principles 322-323 - - dimensionless numbers and process functions 326-328 -- emulsification machines 324-326 - - emulsion gel foods production 329-331 - - high internal phase emulsions (HIPEs) 328 - dispersed phase 316-317 - gel-like type emulsions applications 331-332 -- chemical properties 338-339 -- fat continuous food products 335-337 - - microbiological properties 339 - - water continuous food products 332-335 frequency test 68-69

fuel cells 180–181 fugacity coefficients 140 fumed silica 89

## g

GC-based models 128 GCVOL model 128 gelatin 318 gel-like type emulsions applications 331-332 - chemical properties 338-339 - fat continuous food products 335-337 - microbiological properties 339 - water continuous food products 332-335 gels 75, See also microbial transglutaminase (MTG) – classification 76, 80–81 -- crosslinked gels (chemical gels) 86-87 -- polymer gels 81-86 - definition 76 - particulate gels 87 - - aqueous clay gels 87-89 - - gels produced using particulate solids and high molecular weight polymers 90 - 91-- oxide gels 89-90 - rheological behavior 76-77 – constant stress (creep) measurements 79 - - dynamic (oscillatory) measurements 79 - 80 – stress relaxation (after sudden application) of strain) 51-52, 77-79, See also microbial transglutaminase (MTG) - surfactant systems 91-93 Gibbs energy of mixing 141 Gibbs-Marangoni effect 56 globulins 236 glutelins 228, 230 gluten 227-228, 262 glycinin 230-232 glycosylation 259 good manufacturing practice (GMP) 278, 302-303

# h

Hansen solubility parameters 131 hard sphere 17 – mapping 24–25 – non-spherical particles 20–23 – suspension of spheres viscosity in Newtonian media 17–20 Herschel–Bulkley model 44, 59–60, 114 hexadienoic acid 289 hexagonal phase 91

high frequency modulus, See network modulus high internal phase emulsions (HIPEs) 328-329 high molecular weight polymers 76 high-pressure homogenization 324-325 high pressure-induced gels 231, 232-232 Hildebrand solubility parameter 131 homogeneous formulated products – cost 127 - density 128 - dielectric constant 128-129 - dynamic viscosity 129 - environmental, health, and safety related properties 132 - evaporation time 129 - open cup flash point 131 - solubility parameters 130-131 – surface tension 132 - vapor pressure and heat of vaporization 130 Hooke's law of elasticity 10 Hookean body 62 house of cards structure 88 hyaluronic acid 287 hydroclusters 39-40 hydrolysis 258-259 hydrophilic creams 51 hydrophilic-lipophilic balance (HLB) 134-136, 280 hydrophilic silica 90 hydrosomes 93 hydrothermal synthetic techniques 191

## i

ICAS-property package 145 ideal elastic behavior 62 ideal viscous behavior 62-63 intrinsic viscosity 23, 41 ionic liquids 169-170 - abbreviations 170 - as acido-basic media 171, 182 – – conductivity 176 – dynamic viscosity 176–177 -- fuel cells 180-181 -- organic synthesis 177-180 -- structure 172-174 -- synthesis 171-172 -- thermal properties 175-176 - binary mixtures 182-183, 189-191 -- physicochemical properties 183-186 -- potential applications 188-189 -- structural investigations 186 - catalytic hydrogenation reactions 201, 209

ionic liquids (contd.) -- early developments 202-203 - - SILCA-type materials 205-208 – stereoselective hydrogenation reactions 203-204 -- thermomorphic phases 204-205 140 - and hyperbranched polymers 165-166, 181 - nanoporous materials from ionothermal synthesis 191-192, 200-201 - - aluminophosphates (AlPOs) 193-198 – costructure-directing agents (co-SDAs) 198 - 199-- metalloaluminophosphates 199-200 – silicoaluminophosphates 199 -- zeolites (aluminosilicates) 200 isomorphic substitution 88 Joint Expert Speciation System (JESS) 164 k kafirins 229 Krafft temperature 136 Krieger–Dougherty equation 19, 25, 41–42,

## I

100, 143, 317

Laki-Lorand factor 250 lamellar phase 92 Landolt-Börnstein database 165 lecithin, See phosphatidylcholine legume plant proteins gelation 230-233 – bean 234–235 broad bean 235 - canola protein 234 - cowpea 236-237 - lupin proteins 233 - oilseed proteins 237-238 - pea, chickpea, lentil, and pigeonpea (pulses) 236 - sesame 233 - sunflower proteins 233-234 vegetable/fruit proteins 238 leguminous/oilseed proteins, in gelation 223 linear mixing rule 137 linear viscoelastic region (LVR) 65 linoleic acid 293 linolenic acids 293 lipid continuous phase 319-320 lipophilic creams 51 lipophilic substances penetration 298-300 liquid formulated products thermophysical properties 121-122

- classification 122 - functional bulk property modeling 137 - - based on linear mixing rule 137 - - based on nonlinear mixing rules 137 - functional compound properties in mixtures - performance related property modeling 140-141 - - emulsion formulated products performance properties 142-144 -- flash point 141-142 - - liquid phase stability prediction 141 - properties classification 123-124 - property model classification 124-125 - pure compound property modeling 126 - - emulsified formulated products 132 - 137 – homogeneous formulated products 127 - 132- software tools 144 -- ICAS-property package 145 -- ThermoData Engine (TDE) 144-145 liquid phase stability prediction 141 load jump 58 lotions 51 lupin proteins 233, 254-255

### m

macro-emulsions 301 Maillard reactions 259 maize/corn 229 margarine 329-330 Marrero-Gani method 129, 146-147 Master Sizer 116, 117 mayonnaise 330 Medicines Act 278 melting/phase transition point 186 metalloaluminophosphates 199-200 methylparaben 289 micro-emulsions 53, 282 microbial transglutaminase (MTG) 248 - allergenicity of crosslinked plant proteins 265 - application in food products, containing vegetable protein 261-263 - catalyzed reactions 249-250 - crosslinking protein isolates from pea, lupin, and soybean in food models 263-264 - current sources 250-251 - enzymatic texturization monitoring methods 264 - isopeptide bonds 264 - need for novel sources 251

- plant proteins allergenicity 265-266

- protein sources modification and improvement strategies for crosslinking 258-261 - safety 264-265 vegetable proteins suitable for crosslinking 251 - 258micro-emulsions 53, 282 microgels, See crosslinked gels (chemical gels) microstructured products 122 mini-emulsion 301, 306 modern emulsifiers 52-53 modified Rackett equation 128 modifiers, See gels monoglycerides 319, 321, 336 monounsaturated fatty acids (MUFAs) 338 mucuna bean protein concentrate (MPC) 235 multiple emulsions 282, 316

#### n

nanoemulsions 53-54 nanoporous materials from ionothermal synthesis 191-192, 200-201 - aluminophosphates (AlPOs) 193-198 - costructure-directing agents (co-SDAs) 198 - 199- metalloaluminophosphates 199-200 - silicoaluminophosphates 199 - zeolites (aluminosilicates) 200 napin 234 negative ramp 58 network modulus 86 Newtonian flow behavior 61 Newtonian liquids 8, 42 Newtonian media and suspension of spheres viscosity 17-20 NIST Chemistry web Book 159, 161 nonionic surfactants 281 nonlinear mixing rules 137-140 non-microstructured products 122 non-Newtonian liquids sedimentation 101 non-spherical particles 20-23 noodles 263 nutrient value improvement, in plant proteins 260-261

## 0

oat 230 oil-in-water (O/W) emulsions 51, 315, 321, 326, 333 oil-in-water-in-oil (O/W/O) 316 oilseed proteins 237–238 ointment 51, 279 oleosomes 92, 93 opaque gels 239 open cup flash point 131 organic synthesis 177–180 organo-clays (bentones) 80, 89 organogel-based emulsions and structurant hydration 321 oryzanol 320 oscillatory measurements, for creaming prediction 104–105 oscillatory sweep measurements 112 Ostwald's rule stages 329 Ostwald ripening 337 – and coalescence 109 over-processing 328 oxide gels 89–90

## р

packing geometry 19 Pal equation 143 palierne emulsion model 43-44 panthenol 294 parabens 289 parallel-plate measuring system 13-14 particle size distribution effects 36-38 particle volume fraction 7, 17–19, 23, 25–26, 30, 32, 37 particulate gels 87 - aqueous clay gels 87-89 - gels produced using particulate solids and high molecular weight polymers 90-91 - oxide gels 89-90 patch test studies 290, 292, 297 pea, chickpea, lentil, and pigeonpea (pulses) 236 pea protein 254 péclet number 20, 22 pectins 318 pendular state 33 perfume 290-291 phosphatidylcholine 53-54 physical gels 81-82 physical product design 1 pickering emulsions 284 plateau modulus 44 polymer coil overlap concentration 81 polymer gels - physical gels obtained by chain overlap 81 - 82 produced by associative thickeners 82–86 poly-unsaturated fatty acids (PUFAs) 335, 338 positive ramp test 57 post-hardening 330 potato protein 256-257

precipitated silica 89 preservations 288-290 primary bonds 336 Princen-Kiss model 45 protein aggregation 334-335 protein digestibility corrected amino acid score (PDCAAS) 257 protein efficiency ratio (PER) 257 proteins gels 221-222, 318 cereal crop plants -- maize/corn 229 – – rice proteins 228 -- rye, oat, and barley 229-230 – – sorghum 229 -- wheat proteins 227-228 - evaluation 226-227 - factors determining physical properties 224-226 - legume plant proteins gelation 230-233 --bean 234-235 -- broad bean 235 – canola protein 234 -- cowpea 236-237 - - lupin proteins 233 -- oilseed proteins 237-238 - - pea, chickpea, lentil, and pigeonpea (pulses) 236 -- sesame 233 -- sunflower proteins 233-234 -- vegetable/fruit proteins 238 - product application 238-240 - prospects and challenges 240 structure and formation 222, 224 proteolysis 234

# q

QSAR model 144 QSPR models 134, 136 Quemada model 19, 25, 38

#### r

real viscoelastic behavior 63
red bean globulin (RBG) 235
relative viscosity 8, 23, 30, 37
relaxation modulus 78
release jump 58
repulsive particles 10–28
residual (zero shear) viscosity and sedimentation and creaming correlation examples
aqueous polystyrene latex model suspensions 100
creep measurements for creaming prediction 104

- emulsion creaming prediction 102-103 - non-Newtonian liquids sedimentation 101 - oscillatory measurements for creaming prediction 104-105 - thickeners 101-102 rheopexy 9 rice proteins 228, 253-254 rotational Péclet number 22-23 rotational relaxation time 22 rotational rheometry 12 - concentric cylinder measuring system 12 - 13- cone-and-plate measuring system 13-15 - parallel-plate measuring system 13-14 rotor-stator type machines 324-325 rye 229

#### s

saturated fatty acids (SAFAs) 319, 320, 335-336, 338 SciFinder 266 searle method 12.13 self-healing, of interfacial film 56 self-structured systems 76 semi-dilute range 81 serrated disc disperser 55-56 sesame 233, 255 shear modulus 11 shear rate 14-15 shear stress 14, 98 shear thickening 38-40 shear-thinning region 20 short-term stability, of emulsions 56 SILCA-type materials 205-208 silicoaluminophosphates 199 single point method 16 skin care and cleansing 53 skin care products design 273-276 - cosmeceuticals -- differences with drugs 278-279 -- for healthy skin 277-278 - cosmetic cream bottles 306-309 - cosmetic products for beautifications 276 - 277- cream structure 286 - - active substance groups 291 -- additives 290-291 -- excipients 286-288 -- preservations 288-290 -- typical effects of cosmetics 292 - element design 310-311 - emulsions 280 - - definition, structure, and classification 280-282

 – preparation in laboratory 285–286 -- stability 282-283 essential active substances from medical point of view 292 – – linoleic acid 293 – linolenic acids 293 -- panthenol 294 – – urea 294 - skin care products production 302-306 skin penetration 294 - - emulsion application 296 – lipophilic substances penetration 298 - 300 – proof of performance 297–298 -- skin structure 294-295 - targeted product design 301-302 small amplitude oscillatory shear (SAOS) test 10.34 smart colloids 87 solid catalyst with ionic liquid layer (SCILL) 205 - 206solubility parameters 130-131 solubilization and hydrothermal treatment 259 solvent viscosity 20, 23 solvothermal method 191 sorbic acid 289 sorghum 229, 257-258 soybean products 261 soybean protein 230 soy protein 252-253 soy protein concentrates (SPCs) 252 soy protein isolate (SPI) 230–232, 252 spheroids 20 spring constant 78 Standard Reference Data Program 159 stationary flow behavior 56-58 stationary viscosity value 57 steady flow curve 63-65 steady state shear stress-shear rate measurements 109 stearate creams 52 step test 57 stereoselective hydrogenation reactions 203-204 sterically stabilized dispersions 113-114 sterically stabilized emulsions 114-115 sterol 320 stokes-Einstein equation 20 storage modulus measurement, as function of time 117-118 strain sweep measurements 111-112 strain test, See amplitude dependence stratum corneum 295

stress ramp test 58–61 stress relaxation (after sudden application of strain) 77–79 stress–time ramp 57 strong gels 76 strongly flocculated gels rheology 29–33 structure breakdown and build-up 67–68 sunflower proteins 233–234, 255–256 supported ionic liquid phase (SILP) 205–206 surface-affinity difference (SAD) 135–136 surface tension 132, 136–137, 143–144 surfactant systems 91–93 swellable clays 87 syneresis 99

## t

tangent method 60 Taylor equation 40-41 temperature dependence 70 tempering 335 texturized vegetable proteins (TVPs) 247 ThermoData Engine (TDE) 144-145 thermophysical properties and sources 153 - complex solutions data 162 - database examples 155-156 – Design Institute for Physical Property Data (DIPPR) database 156, 160 – – DETHERM 156–158 -- Dortmund DATABASE (DDB) 156, 159 -- NIST Chemistry web Book 159 - electrolyte solutions properties and databases - - CERE DTU chemical engineering 164 -- closed collections 165 -- DDB 164 -- DETHERM/ELDAR 162-164 -- IESS 164 -- Landolt-Börnstein database 165 - ionic liquids and hyperbranched polymers 165-166 - phase equilibria calculations and thermodynamic properties 154 - reliable sources of data 154-155 thickeners 101-102, See also gels thixotropy 9-10, 18, 91 thread-like micelles 92 time dependence 68 tissue transglutaminase (TTG) 265 tocopherols 284 torque 14, 59 triacylglycerols (TAGs) 319-320, 329, 335-336 triglycerides 319, 320 true shear rate 16

# и

ultra-high temperature processing (UHT) 339 undesired substances removal, from vegetable proteins 259–260 UNIFAC GC-based model 139, 148–149 urea 294

## ν

vapor pressure and heat of vaporization 130 vegetable/fruit proteins 225 vegetable proteins suitable for crosslinking, with MTG 251-252 - canola protein 256 - lupin protein 254-255 – pea protein 254 - potato protein 256-257 - rice protein 253-254 - sesame protein 255 - sorghum protein 257-258 - soy protein 252-253 - sunflower protein 255-256 - wheat protein 253 vicinal 89 viscoelastic materials 8 viscosity measurements 116-117 viscosity ratio 40, 43, 326 viscosity reduction 36-38 Votator process 329, 336

# w

wall slip 108–109 water continuous food products 332–335 water-in-oil (W/O) emulsions 51, 279, 315 water-in-water (W/O/W) emulsions 316 water-in-water (W/W) emulsions 315 weaker gels 76 weakly flocculated gels rheology 29 Weissenberg–Rabinowitch correction 15, 16 wheat proteins 227–228, 253 whey proteins 319

# X

xanthum gum 82, 103

# Y

yield point 59 yield strain 44–45 yield stress 8, 31–33, 45, 59–60 yield value measurement, as function of time 117

# z

zein corn 229 zeolites (aluminosilicates) 200 zero-shear viscosity 18, 23–24, 28, 37