

## INDEX

## A

2-Acyl-1,4-hydroquinone, 149  
 Advanced oxidation processes (AOPs),  
 226  
 Air Act (1981), 46  
 Aldehydes and ketones, oxidation of, 169  
*Alkanna tinctoria*, 151  
 Alkenes and alkynes, oxidation of, 169  
 1-Alkyl-3-methylimidazolium halide, 116  
 Alternative electronic chemicals, 37  
 Ameta, A., 161–198  
 Ameta, C., 283–315  
 Ameta, G., 255–281  
 Ameta, K. L., 283–315  
 Ameta, N., 225–254  
 Ameta, R., 1–7, 43–85, 109–135, 137–160,  
 283–315, 317–351, 353–365  
 Ameta, S. C., 87–108, 225–254, 367–370  
 Amines, oxidation of, 169  
 5-Amino-6-methyl-2-benzimidazolone  
 (AMBI), 243  
 Antifoulants, 74  
 Aromatic aldehydes, reaction of, 167  
 Aromatic nitro compounds, 227  
 3-Arylamino-4-hydroxybenzoates, 37  
*Ascherichia coli*, 77  
*Aspergillus niger*, 12  
*Assamica*, 61–62  
 Atom economy, 5–6  
 5-(Azidomethyl)furfural, 28  
 Azo-bis-isobutyronitrile (AIBN), 172

## B

*Bacillus megaterium*, 89  
 Baeyer-Villiger oxidation, 96  
 Band gap, 201–203  
 Barbier type allylation, 172

Battery Management and Handling Rules  
 (2000), 46

Beckmann rearrangement, 119–120  
 Benjamin, S., 225–254, 255–281  
 1,3-Benzoxazine (Bzf), 30  
 3-Benzoxazine (Bzs), 30  
 Benzoxazines, synthesis of, 30–31  
 Bhardwaj, S., 255–281  
 Bhati, I., 199–224  
 Bio-based material starbons, 69–70  
 Bio-based production system, 10  
 Biocatalysts  
   amoxicillin, enzymatic synthesis, 91  
   asymmetric dihydroxylation, 90  
   bacterial alcohol dehydrogenases, 89  
   baker's yeast, 89  
   enantioselective synthesis, 89  
   *geotrichum candidum*, 88  
   mitochondria, 90  
   penicillin acylase, 88  
   *penicillium citrinum*, 90  
   *saccharomyces cerevisiae*, 89  
   stereoselective benzylic hydroxylation,  
   91  
 Biocomposites  
   disperse phase, 329  
   matrix phase, 329  
   properties  
     fibers geometry and orientation, 336  
     resin surface interaction, 336

Biodegradable bicycle, 46  
 Biodiesel, 32–33, 71  
 Bioethanol, 181  
 Biofuel waste streams, 31  
 Biological reactions  
   acetic anhydride, 265

- N-acetylamino acids, 265
  - Alzheimer's disease, 266
  - N-arylhydroxylamines
  - biologically compounds, 267
  - fine chemical, 267
  - natural products, 267
  - Koenigs-Knorr type, 266
  - properties
    - anticonvulsant, 268
    - anti-inflammatory, 268
    - antimicrobial, 268
    - antitumor, 268
  - Biomedical Waste Rules (1998), 46
  - 2,5-Bis(aminomethyl)furan, 23
  - 2,5-Bis(hydroxymethyl)furan, 23
  - Black tea
    - assamica*, 61–62
    - camilla sinensis*, 61–62
  - Borono-Mannich reactions, 78
  - 2-Bromoacrylate ester, 190
  - 4-Butanediol, 20
  - 1,4-Butanediol (BDO), 20
  - 1-Butyl-3-methylimidazolium bromide (bmimBr), 29, 121
  - 1-Butyl-3-methylimidazolium chloride (bmimCl), 29
  - $\gamma$ -Butyrolactone (GBL), 20
- C**
- Camilla sinensis*, 61–62
  - Candida Antarctica*, 151
  - Candida cylindracea*, 151
  - Carbon dioxide
    - advantages of, 143
    - alkylation, 149–150
    - applications, 143–144
    - Baylis-Hillman reaction, 153
    - catalysis, 151
    - copolymerization of, 35
    - coupling reaction, 149
    - critical temperature, 142
    - Diels-Alder reaction, 144
    - dry ice, 142
    - esterification, 150
    - extraction, 150–151
    - Freidel-Crafts reaction, 144–145
    - Heck reactions, 148–149
    - hydrogenation reactions, 147–148
    - miscellaneous reactions, 153–155
    - oxidation reactions, 146–147
    - oxybromination, 153
    - photochemical reaction, 149
    - polychlorinated biphenyls (PCBs), 155
    - solubility, 151
      - measurements of, 152
      - solid drug's, 152
    - supercritical polymerization, 145–146
    - synthesis, 152–153
    - Taylor-Aris dispersion technique, 154
    - used as solvent, 143
    - Wacker reaction, 154
  - Carbonyl compounds, 175
  - Cellulose
    - acetate, 27
    - conversion of, 28
    - feedstocks, 28–30
    - lignin, 29
    - lignocelluloses, 30
    - nitrate, 27–28
    - sugar alcohol, 29
    - synthesis of, 28
  - Chauhan, N. P. S., 317–351
  - Chemical revolution, 284
  - Chemical vapor deposition (CVD) methods, 36
  - Chiral ionic liquids, 114
  - Chlamydomonas reinhardtii*, 126
  - 2'-Chloroacetophenone, 180
  - 5-(Chloromethyl)furfural, 28
  - 4-Chloro-2-nitrophenol (4C-2-NP), 236
  - Chouhan, N., 43–85
  - Coastal Regulation Zones (1991), 46
  - Coffea arabica*, 62
  - Combined heat and power (CHP), 50
  - Commercial aromatic amines

- carcinogenic properties, 47  
Common salt, 4  
Composites biodegradation  
  mechanisms  
    hydro-biodegradation, 346  
    oxo-biodegradation, 346  
  polymers and plastic products environments  
    aquatic, 345  
    compost, 345  
    landfill, 345  
    soil, 345  
Composites degradation, reuse and recycling  
  incineration, 345  
  plastics recycling phases  
    collection, 342  
    marketing, 342  
    processing, 342  
    separation, 342  
  pyrolysis, 344  
    recyclability parameters  
      mechanical properties, 343  
      PLLA molecular weight, 343  
      reinforcement geometry, 343  
      thermal and rheological behavior, 343  
Conduction mechanism  
  conductor, 289  
  electric current, 289  
Corn, 17  
Crude glycerol, 14  
Cyclic lactide, 18  
Cyclopentyl methyl ether (CPME), 369  
  applications, 183  
  condensation reactions, 185  
  enolate chemistry, 185–186  
  Grignard types reaction, 184  
  melting point, 183  
  nanoparticles, 188  
  palladium catalyzed direct arylation, 185  
  properties of, 182  
    reactions with transition metal catalysts, 184–185  
    reduction, 186–188  
    transformations, 186
- ## D
- N,N-Dialkylated tryptamines, 55  
1,3-Dialkyl imidazolium chloride, 111  
1, 3-Dialkylimidazolium tetrachloroiodates, 116  
4,5-Dichloro-2-n-octyl-4- isothiazolin-3-one, 74  
2,4-Dichlorophenol, 236  
2, 4-Dichlorophenol (DCP), 237  
2, 4-Dichlorophenoxyacetic acid (2,4-D), 236  
Diels-Alder reaction, 96, 120  
4-Dihydro-2H-1, 30  
2-Dihydroquinazolines, 100  
3,4-Dihydroxy-5-alkylaminobenzoates, 37  
1,2-Dimethoxyethane (DME), 182  
3,6-Dimethyl-1, 18  
N,N-Dimethylacetamide, 29  
Dimethyl acetylenedicarboxylate (DMAD), 166  
2,4-Dimethylaniline, 231  
2,3-Dimethyl-1,3-butadiene, 176  
N,N-Dimethylpiperidinium, 117  
N, N-Dimethylpropyleneurea (DMPU), 194  
N,N-Dimethylpyrrolidinium, 117  
2,4-Dinitrotoluenes, 237  
5-Dione, 18  
4-Dioxane-2, 18  
1, 3-Dioxolane, 194, 369  
4,4-Diphenylmethyldiisocyanate, 117  
1-Diphenyl-1-pentene, 154  
2,2-Diphenyl-1-picrylhydrazyl (DPPH), 150  
Dipolar polarization  
  electric field, 288  
  molecules, 288  
Disaccharides, chemical transformation  
  sucrose  
    formic acid formation, 24

hydrolysis of, 23  
 2,4-Disubstituted-1, 100  
 Dodecylbenzene, 58  
 Dodecylbenzenesulfonate (DBS), 210  
 4-Dodecylbenzene sulphonic acid, 58–59

## E

Eco-friendly products  
 application, 45  
 breakthrough concepts, 45  
 chemical substances, 47  
 critical issues, 45  
 ecological system, 44  
 fuels, 45  
 green technology, 46  
 legislative decisions, 46  
 mobile phone, 46  
 modernization, 45

Eco-waxes  
 microcrystalline structure, 65  
 plant sources, 65  
 use in, 65

Electrochemistry, 74

Enterobacteriaceae, 77

Environmental chemistry, 2

Environmental pollution, 2

Environmental Protection Agency (EPA), 52

Environment composition, 10

Environment Protection Act (1986), 46, 64

Environment Protection (Amendment) Rules (2012), 46

Escherichia coli, 89

Ethyl benzoate, 142

2-Ethylhexanoic acid, 150

2-Ethyl-1-hexanol, 150

2-Ethylhexyl-2-ethylhexanoate, 150

Ethyl 3-keto-4,4,4-trifluorobutyrate, 89

Ethyl lactate, 191–192

1-Ethyl-3-methylimidazolium, 112

1-Ethyl-3-methylimidazolium bis(trifluoromethyl), 129

1-Ethyl-3-methylimidazolium chloride (emimCl), 29

1-Ethyl-3-methylimidazolium ethylsulfate, 129

1-Ethyl-pyridinium tetrafluoroborate, 120

1-Ethyl-pyridinium trifluoroacetate, 120

## F

Fatty acid methyl esters (FAME), 148

Fenton's reagent, 228  
 photo-Fenton reactions, 229  
 reaction rates, 229  
 stoichiometric coefficient, 229

Fiber and resin surface interaction  
 adhesion promoters, 339  
 chemical pretreatment, 338  
 matrix shrinkage, 339

Fiber properties  
 cellulose content, 337  
 interfacial bond, 337  
 parallel direction disposed, 337

Fibers geometry and orientation  
 interlocking, 338  
 mechanical properties, 338  
 strength properties, 338  
 surface areas, 338

Fluorous biphasic system (FBS), 193

Fluorous solid-phase extractions (F-SPE), 55

Fly Ash Notification (2000), 46

Formic acid  
 biodiesel, 26  
 carboxyl group, 25  
 fatty chains reactions, 26  
 green formation of, 24–25

Fossil raw materials, 10

Fridal-Crafts reaction, 58

Friedel-Crafts acylation, 122

2,5-Furancarboxaldehyde, 23

2,5-Furandicarboxylic acid, 23

3-Furfuryl-8-methoxy-3, 30

## G

Garcinia mangostana, 62

Geopolymer concrete, 66

- limestone, 67
- sea water, 67–68
- Geotrichum candidum*, 88
- Glucose, 17
- Glycerol
  - advantages of, 178–179
  - applications
    - catalyst design and recycling, 181
    - enhancing reaction selectivity, 180
    - organic synthesis, 179
    - solvent for biocatalysis, 180
    - solvent for separation, 181
    - use in materials chemistry, 181–182
  - structure of, 180
- Gray chemistry, 2
- Green building construction materials
  - energy saving strategies, 66
  - geopolymer concrete, 66–68
  - green cements, 66
  - mineral admixtures, 68–69
  - novacem's cement, 68
  - polycyclic aromatic hydrocarbons (PAHs), 66
  - products of incomplete combustion (PICs), 66
- Green catalysts
  - biocatalyst, 88–92
  - enzymes, 88
  - metallo-catalysts, 102–104
  - organocatalysts, 92–102
- Green chemicals, 3
  - adipic acid, 76
  - analytical methods, 75
  - benzene, reaction mass efficiency (RME), 76
  - chemoselective reaction, 78
  - maleic anhydride, 77
  - principles, 4–5
  - processes, 369
  - transgenic bacteria, 77
  - ultrasound-assisted organic syntheses, 79
- Green chemistry, principles of, 6
- Green composites, 369
  - aircrafts, ships and trains, 340
  - automobiles, 339
  - designing natural processes, 319
  - mobile phones and computers, 341
  - packaging
    - beer and carbonated drinks bottles, 340
    - fruit and dairy paper board, 340
  - products and construction
    - fencing, 341
    - railing, 341
    - siding and shingles, 341
    - window and floor profiles, 341
- Green detergents
  - alkylbenzenesulfonates, 58
  - blue-green algae, 59
  - Fridal-Crafts reaction, 58
  - nitrilotriacetate, 59
  - phosphates, 59
  - sodium citrate, 59
  - sodium tripolyphosphate, 58
  - vegetable oil, 60
  - water hardness, 59
- Green drugs, 51
  - anticonvulsant pregabalin, 54
  - chemical route, 54
  - convenient combinatorial method, 55
  - conventional route, 53
  - N,N-dialkylated tryptamines, 55
  - dihydropyrimidinethiones, 55
  - dihydropyrimidinones, 55
  - ibuprofen, 52
  - indole-1-carboxamides, 56
  - lovastatin, 54
  - 2-methylpropylbenzene, 53
  - microwave synthetic approach, 56
  - microwave technology, 56
  - tryptamines, 55

- volatile organic solvents, 52
- Green dyes
  - acute toxicity of, 63
  - natural dyes, 62
  - petroleum, 61
  - styryl dyes, 63
  - synthetic dyes, 61, 64
- Green fuel
  - fossil fuels, 48
  - hydrogen fuel, 48
    - application of, 50
    - eco-friendly, 50
    - PEC hydrogen, 50
  - light fuel hydrogen, 48
  - water cleavage, 49
- Green manufacturing processes
  - bioplastics
    - non-petrochemical, 359
    - pharmaceutical industries, 360
    - synthesized living organisms, 359
  - chemicals and metals, 356
  - housekeeping
    - chemical and waste inventories, 357
    - eliminating leaks and drips, 357
    - overflow alarms, 357
    - segregating wastes, 357
  - pharmaceutical industry
    - conventional techniques, 357
    - green biocatalytic synthesis, 358
    - organic solvents, 357
    - organic synthetic routes, 357
  - polymer industries
    - chemical and thermal stability, 361
    - chromium compound, 362
    - CNT synthesis process, 359
    - lignocellulosic and biomasses, 359
    - residues food, 359
    - soil and groundwater, 362
    - volatile organic compounds, 360
    - waste material, 361
  - production process
    - automated process control, 354
    - biological, 355
    - chemical, 355
    - environmental impact, 356
    - human intervention, 354
    - neutralization, 355
    - solvent, recycle, 355
    - switching, 355
    - unwanted byproducts, 355
    - volatile organic compounds, 356
  - waste internal reuse
    - energy, 356
    - water, 356
- Green pesticides
  - antibiotics, 50
  - biopesticides, 50
  - carbarnates, 50
  - dipyridyl derivatives, 50
  - germicides, 50
  - insecticides, 51
  - natural pesticides, 51
  - organophosphates, 50
  - phenol derivatives, 50
  - phenoxyherbicides, 50
  - phytoalexin elicitor glucohexatose, 51
  - pyrethroids, 50
  - therapeutic compounds, 51
- Green products
  - bioplastics
    - polythene waste, 47
    - renewable biomass, 47
- Green solvents
  - cyclopentyl methyl ether, 182–188
  - glycerol, 178–182
  - 2-methyltetrahydrofuran, 188–192
  - perfluorinated (fluorous) solvents, 192–194
  - polyethylene glycol, 173–178

water, 162–173  
Green starting materials, 368

## H

Haloaluminate ionic liquids, 114  
Hazardous Waste Rules (1989), 46  
Health Act (1989), 64  
Heterogeneous catalysis  
    acidic clay montmorillonite, 272  
    liquid-liquid systems, 271  
    liquid-solid, 271  
    p-phenyl, reactivity, 272  
    regiochemistry, 272  
*Hibiscus mutabilis*, 62  
Homoeopathy concept, 4  
Horner-Wadsworth-Emmons reaction, 99  
Hydrogen, production of  
    hydrogenolysis, 34  
    1,4-pentanediol, 34  
    triacetic acid lactone, 33  
5-Hydroxy-1, 154  
Hydroxyl radicals, 227, 245  
5-Hydroxymethylfurfural (HMF), 29, 131  
5-Hydroxymethyl-2-furfural (HMF), 102  
3-Hydroxypropionic acid, 20

## I

Indian chemical society, 3  
Indole-2-carboxylic acid, 141  
Ionic liquids  
    aqueous biphasic system, 128  
    classification of, 114  
    designer solvents, 110  
    ethanol ammonium nitrate, 110  
    as green solvent  
        anions, 113  
        cations, 113  
    designer solvents, 112  
    generation, 114  
    hexafluorophosphate, 110  
    in organic reactions  
        Beckmann rearrangement,  
        119–120

    biochemical reaction, 126  
    biodegradation, 126  
    condensation reaction, 124  
    coupling reaction, 124  
    cyclization, 125  
    Diels-Alder reaction, 120  
    esterification reaction, 125  
    Fischer indole synthesis,  
    123–124  
    Friedel-Crafts acylation, 122  
    Heck reaction, 121–122  
    Mannich reaction, 121  
    Michael addition reaction, 123  
    oxidation, 116–117  
    oxidative carbonylation,  
    117–118  
    reduction, 118–119  
    synthesis, 126–127  
    Wittig reaction, 123  
    synthesis of, 114  
        microwave irradiation, 115–116  
tetrafluoroborate, 110  
types, 111  
volatile organic compounds, 110  
Isocyanates, 117

## J

Jain, A., 137–160, 161–198  
Jangid, N., 109–135  
Jhala, Y., 87–108

## K

Kalal, S., 9–41  
Kenaf fiber  
    micro fiber bundles, 323  
    micro fibrillated materials, 323  
    oil palm empty fruit bunch fiber, 324  
    silkworm silk, 323  
    spider dragline silks, 324  
    wood fibers and paper fibers, 324  
*Klebsiella Pneumoniae*, 77  
Kumar, A., 43–85

Kunwar, N., 9–41

## L

Lactate esters, 191

Lactic acid, 18

catalytic upgrading, 19

lactate esters, 19

*lactobacillus delbrueckii*, 19

*penicillium janthinellum*, 19

propylene glycol, 19

*Lactobacillus delbrueckii*, 19

2-Lactylxypropanoic acid, 18

Landfill leachate treatment, 244–245

Laser ablation, 73

Leaf different stages

adverse conditions, 319

aerodynamics and thermal control, 319

changing process, 319

chemistry and physics, 319

damage and attack, 319

deployment and retraction, 319

disposability and recycling, 319

Leaf life cycle assessment

sustainability parameters, 321

biodegradability, 321

health hazards, 321

recycling, 321

renewable resources, 321

transportation, 321

waste prevention, 321

Leaf shapes essential functional attributes

corn husk leaf packaging, 320–21

crab shell architecture, 320

leaf networks, 320

spider web, 320–21

Legislation

Air Act (1981), 46

Battery Management and Handling Rules (2000), 46

Biomedical Waste Rules (1998), 46

Coastal Regulation Zones (1991), 46

Environment Protection Act (1986), 46, 64

Environment Protection (Amendment) Rules (2012), 46

Fly Ash Notification (2000), 46

Hazardous Waste Rules (1989), 46

Health Act (1989), 64

Municipal Solid Waste Rules (2000), 46

Pollution Prevention Act (1990), 46

Rules for Recycled Plastics (1999), 46

Water Act (1974), 46

Linear alkyl sulfonate (LAS), 60

Lithium 2,2,6,6-tetramethylpiperidine (LTMP), 190

Lithography, 74

Livestock wastewater treatment, 244

## M

Magnesium silicate hydrates (M-S-H), 68

Material sustainability

biocatalysis and biotransformations

*aspergillus niger*, 12

enzymes, 12

fermentation techniques, 12

green technology, 12

biodegradation

biodiesel production, 13

biomass, 13

dicyclohexylguanidine group, 14

palladium catalyzed decarboxylation, 14

sol-gel method, 13

carbon dioxide, sequestration

climate change, 12

greenhouse effects, 12

methodologies, 11

oleochemistry, 11–12

photochemistry, 12

renewable feedstocks



- biomolecules, 11
    - fossil-based, 11
    - high molecular weight products, 11
    - polysaccharides, 11
    - terrestrial biomass, 11
  - waste biomass
    - from agricultural processes, 13
    - aqueous phase hydrodeoxygenation, 13
    - atom economic route, 13
    - biodiesel formulation, 13
    - as biofuel, 13
    - catalytic upgrading, 13
    - hydrogenation, 13
    - renewable gasoline, 13
  - Mesoporous silica nanoparticles (MSNs), 17–18
  - Metallocatalysts
    - 1,1,3,3-tetramethylguanidinium, 102
    - Tishchenko reaction, 102
  - Methanol-wetted zinc borates, 154
  - Methyl N-n-butylcarbamate, 152
  - 2-Methylpropylbenzene, 53
  - N-Methylpyrrolidone, 37
  - N-Methyl-2-pyrrolidone, 17
  - 2- or 4-Methyl quaternary salts, 33
  - Methyltetrahydrofuran, 97
  - 2-Methyltetrahydrofuran, 369
  - 2-Methyltetrahydrofuran (2-METHF)
    - in biotransformation, 190
    - ethyl lactate, 191–192
    - hydrolysis of, 190
    - organometallic reactions, 189
    - renewable resources, 188
  - 2-Methyl tetrahydrofuran (2-MeTHF), 182
  - Michael addition reaction, 123
  - Microwave
    - applications, 285
    - chemistry
      - multimode reactors, 290
      - ovens, 289–90
    - effect
      - non-thermal, 291
      - specific, 291
      - electromagnetic, 285
    - limitations of
      - health hazards, 295
      - heating apparatus, 295
      - lack of scalability, 295
      - limited applicability, 295
    - organic synthesis, 285
  - Microwave assisted organic synthesis (MAOS), 369
  - Microwave heating and conventional heating, comparison between
    - efficient sources, 293
    - environmental-friendly chemistry, 294
    - greater reproducibility, 294
    - higher yields, 293
    - increased reaction rate, 292
    - selective heating, 293
    - uniform heating, 293
  - Microwave reactions classification
    - solvent assisted synthesis, 296
    - solvent free synthesis, 297
  - Monosaccharides
    - biphasic solvent system, 22
    - 5-hydroxymethylfurfural (HMF), 22–23
    - 5-(hydroxymethyl)furfural (HMF), 21–22
    - levulinic acid, 21
    - thermal dehydration, 21
    - xylitol hydrogenolysis, 22
  - Municipal Solid Waste Rules (2000), 46
  - Muricauda lutaonensis*, 154
- ## N
- Nanoparticles
    - physicochemical approaches, 74
    - production techniques, 73–74
  - Natural fiber
    - biocomposites
      - cellulose fiber based, 329–30

- flax and hemp based, 331
    - jute based, 331
  - sources
    - acceptable strength, 322
    - stiffness and biodegradability, 322
    - thermal insulation, 322
  - Natural gas approach, 10
  - Natural polymer biocomposites
    - thermoplastic and thermoset biocomposites
      - cellulose based, 334–35
      - polylactic acid based composites, 333
      - starch based composites, 332
  - Nitrilotriacetate (NTA), 59
  - 5-Nitro-1,2,4-triazol-3-one (NTO), 216
  - Non haloaluminate ionic liquids, 114
  - Novacem's cement, 68
- O**
- 3-Octadecyl-8-methoxy-3, 30
  - Oleochemistry
    - applications, 12
    - like fats, 11
    - like oils, 11
  - Organic compounds, 171
  - Organic compounds, photodegradation of
    - alcohols
      - oxidative degradation, 232
      - poly(ethylene glycol), 233
    - carboxylic acids
      - chemiluminescence, 234
      - Fenton's reagent, 233
      - gallic acid, degradation of, 233
      - p-hydroxyphenylacetic acid, 234
      - strongly acidic ion exchange resin (SAIER), 233
    - dyes
      - decolourisation and mineralization, 239
      - decolourisation kinetics, 240
      - heterogeneous catalytic treatment, 241
      - photochemical degradation, 242
      - photo-Fenton reagent, 239–240
    - halo compounds
      - 4-chloro-2-nitrophenol (4C-2-NP), 236
      - 2,4-dichlorophenol, 236
      - 2, 4-dichlorophenoxyacetic acid (2,4-D), 236
    - hydrocarbons
      - 2, 4-hexadiendial, 232
      - reaction products, 232
    - nitro compounds, 237
    - pesticides, 237
      - biological coupled system, 238
      - photo-Fenton degradation, 238
      - tebuthiuron (TBH), 238
    - phenols
      - catechol, 235
      - 2, 4-dichlorophenol, 235
      - Fenton type processes, 234
      - photocatalytic-Fenton degradation, 235
      - photo-Fenton reactions, 234
  - Organic solvents, 162
  - Organic synthesis
    - acetylenes, 264
    - ceric ammonium nitrate (CAN) component
      - aldehyde, 261
      - $\beta$ -ketoester, 261
    - urea, 261
    - 1,3-dipolar cycloaddition, 264
    - false sonochemistry, 263
    - multi-component synthesis
      - amount of p-TSA, 262
      - catalyst in EtOH, 262
    - sodium azide, 264
    - sonochemical switching, 263
    - 1,2,3-(NH)-triazoles, 264
    - Ullmann reaction, 263

## Organic synthesis applications

- alkylation, 301
- condensation, 303–04
- cycloaddition, 302–03
- heterocycles, 306
- ionic liquids, 307–08
- nanocomposites, 306–07
- oxidation, 299
- protection, 304
- rearrangement, 302
- reduction, 300
- transition metal catalyzed coupling, 305

## Organocatalysts

- acid catalysis, 93
- 2-allyl-4-methoxyphenol, 95
- Baylis-Hillman products, 94
- bromination, 98
- cyclohexanone oxime, 94
- Diels-Alder reactions, 96
- ketones, Baeyer-Villiger oxidation, 96
- organocatalytic aldol reaction, 99
- perchlorinated aryl compounds, 93
- tetramethyladipic acid, 92
- thorpe reactions, 92

## Organometallic process

- aldehydes and ketones, 275
- amorphous metals, 274
- enhance reactivity of metals, 273
- enolization, 274
- generation, 275
- organomagnesium, enhancing reactivity, 277
- Simmons-Smith cyclopropanation, 276

## P

Panchal, S., 87–108, 137–160

Paraffins, 14

Passerini reaction, 172

Pathak, A., 109–135

Penicillium janthinellum, 19

Perfluorinated (fluorous) solvents

applications

alcohol, chlorination and bromination, 194

asymmetric allylic alkylation, 193

miscellaneous reactions, 194

oxidation reactions, 193

Stille coupling, 194

fluorous phase technique, 193

perfluorocarbons, 193

perfluorous liquids, 192

Petrochemicals, 16

Petroleum production, 10

Pharmaceutical industries, 3

Pharmaceuticals and personal care products (PPCP), 56

Phenanthrene (PHE), 211

p-Phenylenediamine (PPD), 64

Photocatalysis, 200, 369

band gap, 201–203

heterogeneous, 201

homogeneous, 201

mechanism of

excited electron-hole pair, 204

photo-excitation state, 203

wastewater treatment processes,

205–218

reactions, 201

Photochemical reduction, 73

Photochemistry, 12

Photo-Fenton oxidation, 226

Photo-Fenton reaction, 226–227, 229

aqueous solution, 231

dark Fenton processes, 230

ferric complexes, 231

under homogeneous conditions, 231

photochemical reduction, 230

reaction rate, 230

Photo-Fenton reagent, 369

Phytoalexin elicitor glucohexatose, 51

Pollution Prevention Act (1990), 46

- Polyethylene glycol, 369
- Polyethylene glycol (PEG), 173
- applications
    - 2-amino-2 chromones, synthesis of, 177–178
    - Baylis-Hillman reaction, 177
    - cinnamic acid, decarboxylation of, 177
    - Diels-Alder reaction, 176
    - Heck coupling reaction, 176
    - Heck reaction, 176
    - oxidation reaction, 174–175
    - reduction reaction, 175
    - substitution reaction, 175
    - Suzuki cross-coupling reaction, 177
- Polyhydroxy alkanates (PHA)
- alcaligenes eutrophus*, 327
  - carbon sources
    - 1,4- butanediol, 327
    - 4-hydroxybutyric acid, 327
    - pentanoic acid, 327
    - propionic acid, 327
- Polyhydroxyalkanoates (PHAs), 48
- Poly-3-hydroxybutyrate (PHB), 48
- Polyhydroxyhexanoate (PHH), 48
- Polyhydroxyvalerate (PHV), 48
- Poly(lactic acid) (PLA), 18, 48
- Polymer era, 368
- Polymer natural sources
- cellulose acetate, 326
  - polyhydroxy alkanates, 326
  - polyhydroxy butyrate, 326
  - poly(lactic acid), 326
  - starch, 326
- Polymer synthesis
- radical polymerization steps
    - chain transfer, 269
    - clean and low emission techniques, 270
    - propagation, 269
    - supercritical fluid technology, 270
- Polyoxygenated compounds, synthesis of, 35–36
- Polysialate-disioxo (PSDS), 67
- Polytrimethylene terephthalate (PTT), 20
- Poly(vinyl chloride) (PVC), 216
- Porous carbonaceous materials
- valorization, 34
- Potassium thioacetate, 175
- Procaine penicillin-G (PPG), 243
- 1, 3-Propanediol, 194
- Punica granatum*, 62
- Punjabi, P. B., 9–41, 109–135, 161–198, 225–254
- 2-Pyrrolidone, 37
- ## Q
- 2,4-(1H,3H)-Quinazolinediones, 55
- Quinazolines, 100
- ## R
- Renewable raw material, 10
- Resin properties
- adhesive and toughness, 337
  - good resistance, 337
  - hydrophilic and susceptible, 337
  - interfacial strength, 337
  - thermally stable, 337
  - thermosetting polymer, 337
- Rheum emodi*, 62
- Rhizoma coptidis*, 62
- Rhizopus oryzae* lipase (ROL), 90
- Rosmarinus officinalis*, 155
- Rubia cordifolia*, 62
- Rules for Recycled Plastics (1999), 46
- ## S
- Saccharomyces cerevisiae*, 89
- Scenedesmus quadricauda*, 126
- Sharma, A., 43–85
- Sharma, B. K., 283–315
- Sharma, S., 9–41, 137–160
- Sharma, V., 255–281
- Simultaneous saccharification and fermentation (SSF), 19

- Sodium dodecylbenzenesulphonate, 210  
Sodium perbonate (SPB), 170  
Sol-gel method, 13  
Soni, A., 87–108  
Soni, D., 353–365  
Sonochemical reactions  
  cavitation factors affecting  
    external pressure, 259  
    presence of gas, 259  
    temperature, 259  
    ultrasound frequency, 259  
  cavitation phenomenon, 258  
  sonochemistry principles, 257  
  ultrasound, sonochemistry sources  
    probe system, 259  
    submersible transducer, 260  
    tube reactor, 260  
    ultrasonic cleaning bath, 259  
    whistle reactor, 260  
  ultrasound classification  
    audible sound, 257  
    hypersound, 257  
    infrasound, 256–57  
Starting materials  
  agriculture, renewable feedstock  
    biomass benefits, 17  
    glucose fermentation, 17  
  chemical substitutes  
    benzene, 16  
    formaldehyde, 17  
    methylene chloride, 16  
    vinyl chloride, 17  
    xylenes, 16  
  feedstock, 16  
  organic synthesis, 16  
  petrochemicals, 16  
  succinic acid, 20  
Strongly acidic ion exchange resin (SAIER), 233  
Succinic acid, 20  
N-Sulfopropyl groups, 130  
Sulfur-cured natural rubber, 154  
Sulphides, oxidation of, 170  
Supercritical carbon dioxide (scCO<sub>2</sub>), 368  
Supercritical fluids (SCFs), 71  
  carbon dioxide, 72, 138, 142–155  
  ionic liquids, 72  
  polyester fiber, dyeing of, 72  
  supercritical water (SCW), 138–142  
Supercritical water or carbon dioxide reactors (SCW/CRs), 73  
Supercritical water (SCW), 368  
  amides and esters, hydrolysis of, 142  
  carboxylic acids, decarboxylation of, 141  
  Claisen rearrangement, 140–141  
  Diels-Alder cycloaddition, 140  
  Fischer indole synthesis, 141  
  near critical water (NCW) region, 138  
  organic reactions, 139–140  
  Pinacol-Pinacolone rearrangement, 141  
  reactions occur, 139  
Supplementary cementitious materials (SCMs), 68  
  silica fume, 69  
  types, 69  
Sustainable materials  
  benzene, 16  
  chemical transformation, 15  
  strategies  
    dematerialization, 14  
    detoxification, 14  
    organic chemicals, 14  
Synthetic protocol, principles, 284
- T**
- Tak, P., 199–224  
Task Specific Ionic Liquid [TSIL], 114  
*Terminalia arjuna*, 62  
Tetrabutyl phosphonium hydroxide (TBPH), 170  
Tetrahydrofuran (THF), 20, 182  
Tetramethyladipic acid (TMAA), 92  
1,1,3,3-Tetramethylguanidine acetate, 131

## Thermoplastic starch improvement

- fillers, 328
- lubricants, 328
- plasticizers, 328
- 2,4-Thiazolidinedione, 89
- 2-Thioxoquinazolinones, 55
- Tinidazole, 57
- Titania nanoflowers, 216
- Trametes laccase*, 64
- Trametes polyzona*, 64
- Tributyltin oxide (TBTO), 74
- Trichloroethylene (TCE), 243
- 3, 4, 5-Trihydroxy benzoic acid, 233
- 2,4,6-Trinitrophenol ammonium picrate, 237
- 2,4,6-Trinitrotoluene (TNT), 237

## U

- Ugi reaction, 172
- Ultrasound, 369
- 3-Undecylbithiophene, 145
- Upflow anaerobic sludge blanket (UASB), 244
- Uridine 5-diphosphate N-acetylglucosamine, 88

## V

- $\gamma$ -Valerolactone, production
  - by levulinic acid, 31
- Vardia, J., 353–365
- Vessels and medium reactions
  - dipole moment, 291
  - solvents, 290–91
- Volatile organic compounds (VOCs), 110
- Volatile organic solvents, 368
- Vyas, R., 161–198

## W

- Waste water treatment plants (WWTP), 61
- Wastewater treatment processes
  - alcohols, 212
  - carbonyl derivatives, 214
  - cellulose, 217

## dyes

- azo dyes, 205
- hydroxyl radicals, 208
- methylene blue, 207
- naphthol green, degradation of, 208
  - photocatalysts, 207
  - photodegradation, 206
  - sol-gel synthesis, 207
- halo compounds, 213
  - methods, 214
  - used as solvents, 214
- hydrocarbons
  - photocatalytic degradation, 212
  - platinum, 211
- nitrogen containing compounds, 214
  - dissolved nitrogen, oxidation, 215
    - oxides of, 215
    - photocatalytic process, 215
    - trinitrotoluene, 216
- pesticides, 208
  - organo chemicals, 209
  - photocatalytic degradation, 209
  - photocatalytic oxidation, 209
- phenols, 212
  - 4-chlorophenol, 213
  - photooxidation of, 213
- responsible chemicals, 205
  - surfactants
    - cetylpyridinium chloride, 210
    - organic pollutants, 211
    - sodium dodecylbenzenesulphonate, 210
    - solar photodegradation, 210

## Water

- advantages of, 162–163
- applications
  - aldol condensation, 167
  - Barbier-Grignard type carbonyl alkylation, 171–172
  - benzoin condensation, 167

carbanion equivalents, reaction of, 171  
Claisen rearrangement, 165–166  
Claisen-Schmidt condensation, 167–168  
cycloaddition, 166–167  
dehalogenation, 172  
Diels-Alder reaction, 164–165  
Heck reaction, 168  
hetero Diels-Alder reaction, 165  
Knoevenagel reaction, 168  
multicomponent reactions, 172  
oxidation reactions, 169–170  
photochemical reactions, 171  
radicals reaction, 172  
reduction reactions, 170–171

characteristics properties of, 163  
inorganic reactions, 162  
physicochemical characteristics, 163  
versatile solvent, 163  
Water Act (1974), 46  
Wood fiber mechanical properties  
  dimensions, 325  
  treatment and fillers, 325

## Y

Yasmin, 317–351

## Z

Zinc sulfide nanoparticles, 155  
Zostera marina, 150