

Index

a

- acoustic cavitation 6, 154, 156, 158, 159, 162, 174, 177, 184, 215, 228, 246, 256, 258, 270, 300
- acoustic sensors 15, 80, 82, 323
- advanced oxidation processes (AOPs) 153, 174, 195, 196, 217, 218, 220, 225, 229
- anaerobic digestion (AD) 50, 195, 240, 241
- artificial neural network (ANN) 13, 104–107, 113, 126, 271

b

- Bachelor vortex model 54
- ballast water treatment 181–183
- baseline geometry 26, 37
- beer brewing 301, 328
- bioactive compound extraction 302–304, 328
- biochemical methane potential (BMP) 253, 256, 258, 262, 263
- biodiesel 3, 14, 156, 218, 239, 296–300, 325, 328
- bioethanol 14, 239, 240, 243–250, 260, 263, 267, 269, 270, 301, 325, 326
- biofuels 239, 240, 244, 269, 271, 325, 326
- biogas 240
 - lignocellulosic biomass 260–264
 - production 250–264
 - wastewater and sludge 253–259
- biomass, pre-treatment method 239–271
- bubble internal energy 111

c

- Cavitating venturi (CV) 34, 36, 37, 61, 116
- Cavitation Detection System 84
- cavitation model 65, 120, 123, 127, 133
- cavitation number 23, 25, 26, 34, 36, 154, 156–159, 174, 319, 330
- cavitation yield 165, 179, 203, 207, 208, 293
- cavity dynamics models 34, 108–114, 116, 117, 119, 121, 126, 322
- cellulose 14, 241, 243, 244, 248, 251, 260, 262, 269, 271, 325, 328
- chemical pre-treatment 241, 243, 244
- computational fluid dynamics (CFD) models 10, 12, 13, 29, 33, 34, 35, 37, 50, 51, 55–59, 61, 66, 108, 116, 119–121, 127, 131–136, 148, 159, 317, 319
- confined vortex flow devices 56
- contraction coefficient 25
- COVID-19 149, 304
- critical cavitation number 26
- crystallization 80, 301, 315

d

- data driven models 104–106
- data processing techniques 83
- decarbonisation 251, 315, 330
- discharge coefficient 24–28, 32, 33, 317, 318

disinfection 3, 194, 300
 bacterial 50, 53
 water 11, 13, 14, 50, 84, 86, 147–184,
 195, 220, 324, 325, 329
 distributed wastewater treatment 325,
 326
 dosimetric methods 81
 downstream pressure 23, 25, 209–210
 drinking water treatment 179–180,
 325
 drops, droplet size distribution 124, 125,
 294, 295
 DynaJet® system 53

e

Ecowirl® reactor 53
 effluents 147, 195, 196, 198, 199, 212,
 213, 224, 239
 empirical models
 data driven models 104–106
 per-pass performance model 101–104
 pseudo-reaction kinetics model
 98–100
 emulsification 14, 289, 294–296, 328
 Euler number 57, 81, 317, 318
 Eulerian models 120
 experimental set-up
 centrifugal pump 77
 cutter pump 77
 diaphragm pump 77–78
 gear pump 77
 holding tank 74–76
 in-line sensors 79–80
 lobe pump 77
 peristaltic pump 77
 piping arrangements/fittings 79
 progressive cavity pump 77
 submersible pump 77
 torque pump 78

f

fabrication tolerances 78
 Fenton's processes 225
 filtration technology 182
 flatness 321
 food sterilization 300–301
 fossil fuels 239, 289

g

gas–liquid applications 283–289,
 305, 328
 gas phase equation of state (EoS) 109

h

harnessing hydrodynamic cavitation 14,
 15, 328–330
 hemicellulose 14, 240, 243, 244, 251,
 260, 262, 271, 325, 326
 heterogeneous systems 122–125
 “home-made” devices 78
 hybrid methodology 179, 325
 hydrodynamic cavitation 3, 315
 application 3, 11
 beneficial physico–chemical
 transformations 3–4
 boiling 5
 devices 7–11, 316–323
 flow characteristics 317
 history 6
 liquid 5
 mathematical modelling 4
 types 6
 hydrogen peroxide (H_2O_2) treatment
 221–222

hydroxyl radicals 6, 13, 79, 81, 95, 96,
 102, 110–111, 113, 117–119, 153,
 155, 168, 175, 196, 197, 206, 208,
 215, 293, 305, 320, 322, 324, 325,
 328

i

inlet concentration of pollutant
 200, 206
 in-line sensors 73, 79–80
 inception
 identification 80–84
 industrial applications 84
 control experiment 87
 executing experiments/troubleshooting
 88–89
 hydraulic test 86–87
 mixing/eliminating dead zones 88
 thermal test 87
 inexpensive microphones 83
 intensify processes 325

j

jet hammer pressure 113, 114

k

Keller–Miksis (KM) equation 109

l

lab scale batch hydrodynamic cavitation experiments 247–248
 lignocellulosic biomass (LCB) 14, 95, 239, 242, 260–265, 270
 pre-treatment methods 241–242
 linear/axial flows 23, 49
 liquid–liquid applications 289
 emulsification 294–296
 food sterilization 300–301
 microalgal oil extraction 296–297
 oxidative desulphurization 289–294
 transesterification of oils 297–300
 liquid–liquid systems 122, 328
 liquid vapour pressure 23, 176

m

methanogenesis 250, 251
 micro-scale processes 95–97, 107, 108, 126, 127
 microalgal oil extraction 296–297
 milling energy 241, 269
 mineralisation 102, 195, 201, 217, 227
 minimization of Gibbs free energy (MGFE) method 110, 111
 modelling hydrodynamic cavitation 13, 322
 multi-scale performance models 115
 multiphase system 88, 283

n

net energy gains 244, 262, 264–269
 non thermal plasma 219
 non-invasive sensors 15, 323

o

operating pH 210–213, 222
 orifice based devices 24–34, 41–44, 246
 oxidative desulphurization 14, 289–294
 ozone (O_3) treatment 222–224

p

particle size distribution (PSD) 88, 123, 262, 304, 328
 particle size reduction 304–305, 328
 passive cavitation devices 81
 per-pass degradation coefficient 118, 200, 206
 per-pass degradation factor 102, 118, 121, 199–203, 205, 206, 208, 209, 217, 218, 321
 per-pass performance model 101–104, 117
 peroxyonation 220, 224–225
 pH 14, 80, 97, 154, 174, 206, 210–213, 215, 222, 225, 226, 251
 photocatalytic processes 226, 227, 315
 physical pre-treatments 241
 physico-chemical transformations 3, 4, 6, 7, 13, 95, 315, 322, 323
 physics based models 108
 cavity dynamics models 108–114
 multi-scale/multi-layer models 114–122
 plasma irradiation 219
 pollutant concentration 102, 118, 200, 203, 206–208, 226
 predictive models 126, 323
 pressure drop (ΔP)
 across cavitation device 14, 208–209
 hydrodynamic cavitation 158
 pressure fields 32
 prevailing modelling approaches 97
 pseudo-reaction kinetics model 98–100
 pumped seawater 183

r

radial pressure gradients 58
 Rankine vortex model 54
 Rayleigh Plesset equation 108, 133, 134
 Reynolds Averaged Navier Stokes (RANS) 33, 35, 132
 Reynolds number 24, 25, 81, 318
 rotor-stator hydrodynamic cavitation devices 49–52

S

- saturated vapour pressure 32–33, 135
sewage wastewater treatment
 180–181
shockwave pressure 111
singing vortex 57, 82
single bubble dynamics model
 109
solid-liquid applications 301
 beer brewing 301
 bioactive compound extraction
 302–304
 particle size reduction 304–305
soluble chemical oxygen demand (SCOD)
 50
sparged gases 214, 284
steam explosion 241, 244
swirling flows 7–9, 12–13, 44, 49–67, 78,
 161, 316–319
synergistic index 172, 218, 221, 222, 224,
 225, 228, 229, 324

t

- temperature, operating 213–214
3D Large Eddy Simulation (LES) models
 34, 36
3D swirling flows 55
turbulence models 123, 133
turbulent pressure fluctuations 7, 81,
 112, 135

u

- ultrasonic cavitation 6, 7, 112, 116, 117,
 213, 316
ultraviolet 153, 218

v

- value-added chemicals 239
venturi based devices 8, 34–41, 43, 44,
 316
visualisation method 81
vortex based cavitation devices 52–59,
 119, 122, 124, 158, 205, 270, 317,
 321
vortex throttle type devices 60

W

- wall angle 39, 41
waste activated sludge (WAS) 50
wastewater treatment
 application 198–199
 augmentation 217–228
 by catalyst based AOPs 225–228
 chemical based AOPs 220–225
 energy sources 218–220
 cavitation devices 197
 hot spot theory 201
 influence of device design 203–206
 operating parameters 206–217
 techniques 194
water disinfection 147
conventional methods 149–154
 drawbacks 152–153
 emerging newer methods 153–154
hybrid methods 165–170
 aeration 169–170
 conventional 168
 hydrogen peroxide 168–169
 ozone 169
hydrodynamic cavitation 148, 154
 devices/reactors 159–162
 kinetics 162–165
 principle 154–158
 state of the art 158–159
natural oils 170–174
 conventional vs. hybrid processes
 174–176
cost calculation 178–179
cost comparison 177–178
process economics 177–179
temperature effects 176–177

water per-capita 193, 194

water-borne diseases 147

water-borne viruses 147

X

- x-ray tomography 320
xylose 243

Z

- zero crossing rate (ZCR) 84, 86