

Index

a

- acetophenone 167
- anisole 162
 - di-*n*-butyl ether 167
 - *vs.* ethanol 167
 - *vs.* higher cetane number oxygenates 160

b

- benzenoids
 - acetophenone 167
 - anisole 162
 - – di-*n*-butyl ether 167
 - – *vs.* ethanol 167
 - – *vs.* higher cetane number oxygenates 160
 - benzyl alcohol 162, 167
 - cellulose
 - – biomass 174
 - – chemical structure 175
 - – H/C vs O/C ratios 174
 - European fuel quality standards 160
 - lignin, *see* lignin
 - physiochemical properties 159–161
 - SI engines
 - – acetophenone 171
 - – benzyl alcohol 171
 - – ethanol 173
 - – guaiacol 173
 - – methyl aryl ethers 168
 - – toluene 172
 - – 2-phenyl ethanol 171
 - 2-phenyl ethanol 162, 165, 167
 - biofine process 100, 154, 155
 - biomass pyrolysis oils
 - composition ranges 189
 - distillation fractions 190, 191
 - production pathways
 - – catalytic cracking 201

– – catalytic hydrodeoxygenation 196

– – conventional petroleum refinery 195

– – hydrocracking 200

– – hydrogen consumption 198

– – hydrotreating 196

– – PUBO 196, 199

BL, *see* butyl levulinate (BL)

brake mean effective pressure (BMEP) 113

Butamax 54

butyl levulinate (BL)

– diesel blending

– – emission results 96

– – OH chemiluminescence 96

– – part-load performance 95

– – soot luminosity 96, 99

– fuel properties 87, 88

– miscibility 89

– oxygen content 92

c

carboxylic acid number (CAN) 190

cetane numbers (CN) 8, 160, 165, 167,

168, 193

combustion process

– CI 1, 2, 7

– diesel pilot combustion 23

– dual fuel combustion 19

– fuel properties 1

– HCCI 2

– – auto ignition 11

– – combustion rate 10

– – distributed reaction 10

– – fuel rating 14

– – *iso*-octane 10

– – late combustion 11

– – physical properties 12

– – Scania 2-l cylinder truck engine 10

– lean/rich dilution limits 3

- combustion process (*contd.*)
 - PPC
 - - chemical properties 17
 - - concept 16
 - - HC and NO_x, gradual changes of 17
 - - HCCI and CI 16
 - - physical properties 18
 - pre-chamber SI combustion 21
 - RCCI 18
 - SI 1, 2
 - - auto ignition 4
 - - flame propagation 2
 - - knock 3
 - - laminar flame speed 2
 - - physical properties 7
- compression ignition (CI)
 - engines 1, 2, 7, 122
 - benzenoids, *see* benzenoids
 - biomass pyrolysis oils 193
 - DMF
 - - applications 124
 - - EGR rate 122
 - - heat release rate 122, 123
 - - soot and NO_x emissions 123, 124
 - DNBE
 - - combustion properties 91
 - - high cetane ranking 89, 90
 - - ignition tendency 89, 90
 - - spray parameters 89, 90
 - - vs.2-MTHF, emissions and efficiency 91, 92
 - *iso*-butanol 48
 - *n*-butanol 41
 - *n*-octanol 50
 - *n*-pentanol 48
 - 2-MTHF
 - - data-driven model-based approach 146
 - - emission results 147
 - - engine-out emissions 145
 - - lubricity and tribology properties 147
 - - model-based analysis 146
 - - TGA analysis 148
 - - valerates
 - - CO, unburnt HC and NO emissions 75
 - - FSN values 76
 - - global performance 77
 - - ignition delay 74
 - - indicated efficiency 74
 - - single-cylinder bench 73
- d**
 - di-*n*-butyl ether (DNBE)
 - CI engines
 - - combustion properties 91
- - high cetane ranking 89, 90
- - ignition tendency 89, 90
- - spray parameters 89, 90
- - vs.2-MTHF, emissions and efficiency 91, 92
- fuel properties 87
- production pathways 98
- diesel pilot combustion 23–24
- DNBE, *see* di-*n*-butyl ether (DNBE)
- dual fuel combustion
 - chemical properties 21
 - concept 19
 - ignition delay 20
 - issues 20
 - natural gas 19, 20
 - physical properties 21
- e**
- EL, *see* ethyl levulinate (EL)
- engine control unit (ECU) 41
- ethanol 29, 30, 50, 54, 80, 81, 105–107, 113, 115, 116, 126, 133–139, 141, 167, 173, 178
 - ethyl levulinate (EL)
 - diesel blending
 - - effects of 93
 - - part-load performance 94
 - - single cylinder engine 94
 - - fuel properties 87, 88
 - - miscibility 89
 - - oxygen content 92
 - European committee for standardization (CEN) 159
 - exhaust gas recirculation (EGR) 4, 17, 46, 50, 94–96, 118, 122, 123, 138–139, 162, 167
- f**
- federal transient protocol (FTP) 142
- flame lift-off length (FLoL) 160
- fuel oxygen content 162, 165, 168
- furanoids
 - compression ignition engines (CIE) 145
 - production pathways, *see* production pathways
 - spark ignition engines, *see* spark ignition (SI) engines
 - 2-MF and 2-MTHF 132
- furfuryl alcohol (FFA) 53, 150, 151
- g**
- gamma-valerolactone (GVL) 59, 60, 80, 151
- gasoline particulate filters (GPFs) 120
- gasoline-type combustion 154

h

- heat release rates (HRR) 49, 68, 122, 123
 higher alcohols
 – butanol isomers 29
 – combustion properties 32, 33
 – *iso*-butanol
 – – cellulosic yeast strains 54
 – – CI 48
 – – lignocellulosic feedstocks 54
 – – SI engines 40
 – lignocellulose 50
 – limitation 54
 – *n*-butanol
 – – blending recommendations 32
 – – CI 41
 – – lignocellulosic feedstocks 54
 – – lignocellulosic-based pathways 51
 – – SI engines 38
 – *n*-octanol
 – – CI 50
 – – lignocellulosic-based pathways 52
 – *n*-pentanol
 – – blending recommendations 32
 – – CI 48
 – – SI engines 40
 – physical and chemical properties 30, 32, 40

- homogeneous charge compression ignition (HCCI) 1, 2, 145
 – auto ignition 11
 – distributed reaction 10
 – fuel rating 14
 – *iso*-octane 10
 – late combustion 11
 – physical properties 12
 – Scania 2-l cylinder truck engine 10
 HRR, *see* heat release rates (HRR)
 hydroxymethylfurfural (HMF) 107
 – catalysts 111
 – dehydration reaction 109
 – to DMF 111, 112

i

- indicated mean effective pressure (IMEP) 17, 46, 67, 69, 76, 97, 113, 115, 116, 118, 119, 138

k

- knock-limited spark advance (KLSA) 115, 171

l

- LA, *see* levulinic acid (LA)
 levulinates
 – fuel properties 87, 88

m

- miscibility 89
 – production pathways 87, 100
 levulinic acid (LA) 60, 80, 87, 100–102, 109, 110, 131, 150, 152
 lignin
 – biomass 174
 – building blocks 175, 176
 – catalytic solvolysis
 – – benzyl alcohol 184
 – – ethyl-guaiacol 183
 – – guaiacol 182
 – – methyl-guaiacol 182
 – chemical structure 175
 – conversion approaches 176
 – H/C vs O/C ratios 174
 – hydrothermal processing
 – – 4-ethyl guaiacol 178
 – – 4-methyl guaiacol 177
 – – guaiacol 177
 – market volume/pricing 185
 – product distribution 184
 – solvolysis
 – – ethanol concentration 178, 180
 – – 4-ethyl guaiacol 180
 – – 4-methyl guaiacol 179
 – – guaiacol 179
 – – monomer yields 178, 181
 low heating value (LHV) 30, 70, 113, 135, 141

low molecular weight alcohols 29

- low temperature combustion (LTC) engine 41, 122
 Luminosity *vs.* time for different fuels 160

m

- motor octane number (MON) 4–6, 32, 106, 171

n

- negative temperature coefficient (NTC) 62, 64, 132, 171

o

- octane index (OI) 5, 171–173

p

- partially homogeneous charge compression ignition (PCCI) 145
 partially premixed combustion (PPC)
 – chemical properties 17
 – concept 16
 – HC and NO_x, gradual changes of 17
 – HCCI and CI 16

- partially premixed combustion (PPC) (*contd.*)
- physical properties 18
 - partially premixed compression ignition (PCCI) 122–124
 - partially upgraded bio-oil (PUBO) 196, 199–202
 - pre-chamber spark ignition 21, 22
 - production pathways
 - biomass pyrolysis oils
 - – catalytic cracking 201
 - – catalytic hydrodeoxygenation 196
 - – conventional petroleum refinery 195
 - – hydrocracking 200
 - – hydrogen consumption 198
 - – hydrotreating 196
 - – PUBO 196, 199
 - biphasic reactor 108
 - carbohydrates conversion 108
 - classification 108
 - extracting phase 109
 - fructose conversion 108, 109
 - HMF 107
 - – catalysts 111
 - – dehydration reaction 109
 - – to DMF 111, 112
 - hydrogenolysis reaction 107
 - levulinic acid 110
 - single-vessel reactor 111
 - 2-MF
 - – FFA 150
 - – furanic fuel compounds 150
 - – furfural to 2-MF 150
 - – LA 150
 - – 2-MTHF
 - – conceptual process design 153
 - – ionic liquids 152
 - – LA 151
 - – levulinic acid to 2-MTHF 151
 - – Re/Pd and Re/Ni catalysts 151
 - – ruthenium-based catalyst approach 152
 - versatile and multi-functional compound 107
- r**
- rapid compression machines (RCM) 62, 132, 134
 - reaction network flux analysis (RNFA) 155
 - reactivity controlled compression ignition (RCCI) 18–20
 - research octane number (RON) 4–6, 32, 33, 106, 171, 172
- s**
- scanning mobility particle sizer (SMPS) 119
 - soot- NO_x tradeoff 162, 164
 - solvolysis
 - ethanol concentration 178, 180
 - 4-ethyl guaiacol 180
 - 4-methyl guaiacol 179
 - guaiacol 179
 - monomer yields 178, 181 - spark assisted compression ignition (SACI) 14
 - chemical properties 16
 - initial flame propagation 14, 15
 - lean limit 14
 - physical properties 16
 - SI and HCCI 14, 15
 - spark ignition (SI) engines 1, 2
 - auto ignition 4
 - benzenoids
 - – acetophenone 171
 - – benzyl alcohol 171
 - – ethanol 173
 - – guaiacol 173
 - – methyl aryl ethers 168
 - – toluene 172
 - – 2-phenyl ethanol 171
 - biomass pyrolysis oils 192
 - characteristics 114
 - comparable combustion 113
 - cylinder pressure profiles 116
 - DISI engine 112
 - DMF
 - – spark ignition engines 112
 - – applications 120
 - – dual injection strategy 118
 - – gaseous emissions 118
 - – GPFs 120
 - – injection strategy 117
 - – PM emissions 119
 - – soot emissions 120
 - engine knocking 113
 - flame propagates 2
 - higher alcohols
 - – *iso*-butanol 40
 - – *n*-butanol 38
 - – *n*-pentanol 40 - injection timing 117
 - KLSA 115
 - knock 3
 - laminar flame speed 2
 - lean/rich dilution limits 3
 - mass fraction 115, 116
 - octane rating 113
 - physical properties 7

- Schlieren images, DMF 114
- spark timing 114, 115
- 2-MF
 - adiabatic flame temperature 137
 - anti-knock behavior 141
 - auto-ignition 132, 134
 - EGR rate 138
 - vs ethanol 138
 - gas temperature 133
 - gaseous emissions 139, 140
 - HV/LHV ratio 136
 - laminar burning velocity 137
 - load operation 134, 135
 - MBT/KLSA spark timings 135
 - octane rating 132
 - particle mass emissions 141
 - PM size distribution 140
 - pre-ignition 136
 - RCM experiments 132
 - shock-tube experiments 132
 - vapor pressure curve 136
- 2-MTHF 141
 - benzene emissions 142
 - FTP 142
 - knock resistance 142
 - levulinic acid 142
 - load variation results 142
 - valerates
 - cylinder pressure and HRR 68
 - efficiency and CO₂ emissions 67
 - ignition delay 69
 - NO and UHC emissions 67
 - single-cylinder bench 66
 - VVT system 112
- t**
- technology readiness level (TRL) 102, 124, 155
- thermogravimetric analysis (TGA) 120, 148, 149
- total acid number (TAN) 190, 201
- total hydrocarbon (THC) 38, 46, 48, 49
- 2,5-dimethylfuran (DMF)
 - advantages 107
 - bioethanol uses 105
 - compression ignition engines
 - applications 124
 - EGR rate 122
 - heat release rate 122, 123
 - soot and NO_x emissions 123, 124
 - ethanol and gasoline 105
 - MON 106
 - oxygenated nature 106
 - production pathways 107
- properties 106
- RON 106
- spark ignition engines 112
 - applications 120
 - dual injection strategy 118
 - gaseous emissions 118
 - GPFs 120
 - injection strategy 117
 - PM emissions 119
 - soot emissions 120
- 2-methyl furan (2-MF) 131
 - production pathways
 - FFA 150
 - furanic fuel compounds 150
 - furfural to 2-MF 150
 - LA 150
 - SI engines
 - adiabatic flame temperature 137
 - anti-knock behavior 141
 - auto-ignition 132, 134
 - EGR rate 138
 - vs ethanol 138
 - gas temperature 133
 - gaseous emissions 139, 140
 - HV/LHV ratio 136
 - laminar burning velocity 137
 - load operation 134, 135
 - MBT/KLSA spark timings 135
 - octane rating 132
 - particle mass emissions 141
 - PM size distribution 140
 - pre-ignition 136
 - RCM experiments 132
 - shock-tube experiments 132
 - vapor pressure curve 136
 - 2-methyl tetrahydrofuran (2-MTHF) 90, 91, 131, 132, 154, 155
 - CI engines
 - data-driven model-based approach 146
 - emission results 147
 - engine-out emissions 145
 - lubricity and tribology properties 147
 - model-based analysis 146
 - TGA analysis 148
 - production pathways
 - conceptual process design 153
 - ionic liquids 152
 - LA 151
 - levulinic acid to 2-MTHF 151
 - Re/Pd and Re/Ni catalysts 151
 - ruthenium-based catalyst approach 152
 - SI engines
 - benzene emissions 142
 - FTP 142

- 2-methyl tetrahydrofuran (2-MTHF) (*contd.*)
– – knock resistance 142
– – levulinic acid 142
– – load variation results 142
- u**
ultralow sulfur diesel (ULSD) 41
unburned hydrocarbons (UHC) emissions
 66, 67, 70, 71
- v**
valerates
– applications 59
– CI engines
– cylinder pressure and HRR 68
– efficiency and CO₂ emissions 67
– ignition delay 69
- – NOx and UHC emissions 67
– – single-cylinder bench 66
– fuel properties 61
– optimum regions 61, 62
– – SI performance, *see* spark ignition (SI)
 engines
– kinetic properties 62
– lignocellulose conversion 59, 60, 78, 79
– pollutant emission study
 – benzene 71
 – ethylene 71
 – low heating value 70
 – methane 71
 – operating conditions 69
 – UHC 70
– production processes 80
variable valve timing (VVT) 17, 112