

Index

- Accelerated solvent extraction (ASE), 100
- Acid sludge, 193
- Activity data, 169–71
- Aeration ponds, 186, 190
- Agricultural land and Santa Maria oil pumps, 102
- Air emissions:
- cleaner production, 179–85
 - compressor engine exhausts, 184–5
 - summary, 26–9
 - tank cleaning, 183
 - turnarounds, 183
 - vacuum jets, 184
- Air pollution:
- best practices, 163–5
 - definitions, 161–3
 - liquid waste streams, 191
- Air pollution control device (APCD), 221–2
- Air quality:
- guidelines, 243
 - standards for petroleum refining, 218–20
- Alaska and Exxon Valdez oil spill, 115, 117
- Alberta refinery and emissions, 175
- Alkenes, 23
- Alkylation, 69–71
- All emission factors are equal (assumption), 136–8
- Alumina catalyst, 216
- AME *see* American Society of Mechanical Engineers
- American Petroleum Institute (API):
- benzene, 36
 - calculated emissions, 136–7
 - DIAL measurements, 175
 - EPA protocol, 123, 125–6
 - gravity, 20–1
 - high emissions, 143
 - naphthenic crude oils, 20–1
 - separator sludge, 186
 - separators, 202, 204
- American Society of Mechanical Engineers (ASME), 84
- Amines, 75–6, 206
- Ammonia (NH₃), 179, 181
- AP–42 *Compilation of Air Pollutants Emission Factors*:
- Claus sulfur recovery plants, 217
 - emissions calculations, 135, 137–8, 214
 - emissions inventories, 125
 - fugitive emissions, 149
 - refinery processes, 2
 - roof landing losses, 141
 - volatile organic compounds, 140–2
- APCD *see* air pollution control device
- API *see* American Petroleum Institute
- Aqualac oxidation scrubbing process, 218
- Aromatic compounds:
- hydrocarbons, 20, 23, 174
 - refineries, 24–5
 - solvent extraction, 51
- ASE *see* accelerated solvent extraction
- Asphalt:
- plant maintenance, 201
 - production, 76–7
- Assays for crude oils, 21
- Athabasca tar sands, Canada, 2
- Atmospheric distillation, 47, 49
- Average Emission Factor Method, 126–31
- Aviation gasoline, 19
- Baker et al v. Chevron* case, 25
- Baumé scale (specific gravity), 20
- Bay Area (BA) Air Quality Management District, California, 140, 213
- Beaven Process, 180–1, 218
- Benzene:
- American Petroleum Institute, 36
 - crude oil, 25
 - DIAL measurement, 167
 - emissions, 25–6
 - Environmental Protection Agency, 25
 - fugitive emissions, 122–3, 143–4
 - gasoline, 25, 36
 - refineries, 10–12, 24–6, 35–6, 99
 - steam traps, 149

- Benzene: (*Contd*)
toxicity, 174
wastewater levels, 185
- Best practices:
air pollution, 163–5
cleaner production, 179–97
- Biochemical oxygen demand (BOD), 185
- Bioremediation and Exxon Valdez oil spill, 116
- Blending (refining technology), 77–8
- BLM *see* Bureau of Land Management
- Blowdown systems, 81, 83–4, 181
- Boosting stations, 12–13
- BP West Coast Products LLC, 143
- BTEX compounds, 38
- Bulk storage and drums, 204
- Bureau of Land Management (BLM), 100–1
- Butane, 48
- Calculation Workbook for Oil and Gas Production Equipment Fugitive Emissions*, 126
- California Air Quality Management Board, 122, 140, 213
- California Coastal Commission, 111
- California Environmental Quality Act (CEQA), 111
- Carbon dioxide (CO₂), 24, 206–7, 212, 222
- Carbon monoxide (CO), 179–80, 212, 222
- Cassegrain telescope, 167
- Catalysts:
metals, 194
waste disposal, 204
- Catalytic converters, 36–7
- Catalytic cracking, 57
- Catalytic hydrotreating, 64–6
- Catalytic processes, 44
- Catalytic reforming, 62–4
- CEQA *see* California Environmental Quality Act
- Chemical oxygen demand (COD), 185
- Chevron Corporation, 25, 101, 103
- Chlorofluorocarbons (CFCs), 18
- Chromium:
elimination, 208
wastewater, 185
- Citgo Petroleum Corporation (CITGO), 122–3
- Clarifiers, 186, 189, 191
- Claus process, 73, 180–1, 206, 216–18
- Clean Air Act, 1970, 36, 123–4
- Cleaner production, 179–225
air emissions, 179–85
emission testing programs, 218–24
flaring reduction, 208–16
good housekeeping, 197–208
sulfur recovery, 216–18
waste solids, 193–7
wastewater, 185–93
- Cleanup:
Exxon Valdez oil spill, 115–16
Santa Barbara oil spill, 1969, 110
- Coker feedstock and oily sludge, 207
- Coking processes, 55–7
- Color of crude oils, 21
- Column distillation, 48–9
- Compressor engine exhausts and air emissions, 184–5
- ConocoPhillips Corporation, 101, 102
- Contaminants, 244–7
- Continuous coking, 56–7
- Coolers, 79–80
- Cooling towers, 92–3
- Correlation Equation Method, 132, 133–5
- Corrosion in refineries, 23, 49–50
- ‘Cracking’, 53
- Crude oils:
API gravity, 20–1
assays, 21
benzene, 25
carbon dioxide, 24
classification, 21, 23
color, 21
composition, 20–6
diatomaceous earth, 46
Exxon Valdez oil spill, 114
hydrocarbons, 21–2
hydrogen sulphide, 21
inorganic salts, 24
metals, 24
naphthenic components, 20–1
nitrogen, 24
non-hydrocarbons, 23–6
oxygen compounds, 24
paraffinic components, 20–1

- pressure in wells, 3
- pretreatment, 45
- refining, 19–39
- Santa Barbara oil spill, 1969, 109
- ‘sour’, 20–1
- sulfur, 20–1, 23, 216–18
- ‘sweet’, 21
- West Texas Intermediate, 20
- Crude-oil distillation, 46–51

- DAF *see* dissolved air flotation
- De Marchi, S., 151–3
- DEA *see* diethanolamine
- ‘Declaration of Dakar’, 37
- Decommissioned petroleum sumps, 100–1
- Definitions of air pollution, 161–3
- Delayed coking, 55
- Density *see* specific gravity
- ‘Desalting’ of crude oils, 45–6
- DGA *see* diglycolamine
- Di-isopropanolamine (DIPA), 181, 206
- DIAL *see* differential absorption detection and ranging
- Diatomaceous earth and crude oils, 46
- Dienes, (diolefins), 23
- Diesel fuels, 29
- Diethanolamine (DEA), 180, 206
- Differential absorption detection and ranging (DIAL), 159, 165–8, 175
- Diglycolamine (DGA), 206
- Diolefins (dienes), 23
- DIPA *see* di-isopropanolamine
- Dissolved air flotation (DAF), 186, 202
- Distillation:
 - crude oils, 46–51
 - processes, 39
- Domestic heating oils, 29
- Drilling rigs, 3–12
- Drinking water in Santa Monica, 38
- Drums and bulk storage, 204

- Ecological impact of Santa Barbara oil spill, 1969, 109–10
- EIG *see* Environmental Integrity Group
- Electrostatic desalting, 45
- Emergency Planning and Community Right-to-Know Act (EPCRA), 150, 152

- Emissions:
 - air, 179
 - Alberta refinery, 175
 - factors, 19
 - flaring, 212–13
 - testing programs, 218–24
- Environment Canada, 123, 168
- Environment and Exxon Valdez oil spill, 114–15
- Environmental health and Santa Maria oil pumps, 99–100
- Environmental improvement and good housekeeping, 197–208
- Environmental Integrity Group (EIG), 121
- Environmental justice and Exxon Valdez oil spill, 116–17
- Environmental Protection Agency (EPA):
 - AP-42 Air Pollutants Emission Factors*, 141–2, 217
 - benzene, 25, 36
 - cooling water treatment, 208
 - correlation equations, 159
 - emission factors, 137, 160, 172
 - fugitive emissions, 1–2, 121, 123, 124–6, 139–40, 174–51
 - Inspector General, 150
 - instrumental test methods, 222
 - petroleum refining industry, 151
 - Profile of the Petroleum Refining Industry*, 179
 - Protocol for Equipment Leak Emission Estimates*, 6
 - Toxic Release Inventory, 121–3, 151–3
 - volatile organic compounds
 - losses from storage tanks, 185
 - under-reporting of emissions, 150, 174
- Environmental Surveying System (ESS), 167
- EPA *see* Environmental Protection Agency
- EPCRA *see* Emergency Planning and Community Right-to-Know Act
- ESS *see* Environmental Surveying System
- ETBE *see* ethyl tertiary-butyl ether
- Ethyl tertiary-butyl ether (ETBE), 38
- Ethylbenzene, 25, 49, 174
- Ethylene, 24
- Exposure to hydrocarbons, 202

- Exxon Valdez oil spill, 113–19
Alaska, 115, 117
bioremediation, 116
cleanup processes, 115–16
environment, 114–15
environmental justice, 116–17
event, 113–14
government response, 117
- FCCU *see* fluidized bed catalytic cracking unit
- Flare gas recovery units (FGRUs), 214–16
- Flares, 86–91
- Flares at Petroleum Refineries*, 213
- Flaring:
blowdown system, 83
emissions, 212–13
hydrocarbons, 212
leak detection and repair, 214
meteorological conditions, 213
pressure-relief, 83–4
reduction, 208–16
refineries, 210–12
smokeless capacity, 212
steam, 213
thermal radiation, 212
- Flotation units, 186, 188, 191
- Flow control valves, 181
- Fluid catalytic cracking (FCC), 26, 58, 60
- Fluidized bed catalytic cracking unit (FCCU), 196–7, 200, 204
- Formulating and blending of hydrocarbons, 44
- Fractionation, 46–51
- Fugitive emissions:
inherent flaws, 136–50
international practices, 153–74
introduction, 121–4
IPCC Assessment, 153–74
leaks, 198
methodology, 124–36
nonpoint sources, 179–80
steam traps, 199
toxic release inventory, 150–3
volatile organic compounds, 122, 139, 140, 144
- Garyville, Louisiana refinery, 19–20
- Gas:
Btu content, 14
field operations, 2–13
natural, 13
plants, 13–19, 74–5
- Gas/air compressors and turbines, 93
- Gasoline:
antiknock properties, 25
aviation, 19
benzene, 25, 36
distillation processes, 39
lead, 36–7
octane number (antiknock), 26
properties, 26, 35
refinery leaks, 144
vapor pressure, 26
volatility, 26
- Ghawar Field, Saudi Arabia, 2
- GHG *see* greenhouse gas
- Good housekeeping for improved environmental performance, 197–208
- Government response to Exxon Valdez oil spill, 117
- Grease manufacturing, 78
- Greenhouse gas (GHG) emissions, 208, 212
- Gulf Refinery, Hooven, Ohio, 187
- Hamiilton J.T., 151–3
- HAP *see* hazardous air pollutant
- Hazardous air pollutant (HAP), 140
- Heat exchangers, 79–80
- Hensley v. Hoss* case, 122
- HF *see* hydrofluoric acid
- HNU meter, 157
- Horizontal venturi flares, 88
- Hydrocarbons:
alkenes, 23
aromatic, 20, 23, 174
crude oils, 20–3
dienes, 23
exposure, 202
flaring, 212
formulating and blending, 44
liquid waste streams, 191–2
naphthenes, 23

- paraffinic series, 22
- properties, 21–2
- Hydrocracking, 60–2
- Hydrofluoric acid (HF), 36, 207
- Hydrogen production, 75–6
- Hydrogen sulfide (H₂S):
 - amine treatment, 206
 - cleaner production, 179–81
 - flare gas recovery unit, 214
 - gas streams, 180
 - non-hydrocarbons, 23
 - 'sour' crude, 20–1, 186
 - sulfur recovery, 216–18
- IDLH *see* Immediate Dangerous to Life and Health
- IFP-1 process in Claus reaction, 217
- IFP-2 oxidation scrubbing process, 218
- Immediate Dangerous to Life and Health (IDLH) values, 231, 234–8
- Impurities treatment processes, 44
- Inherent flaws in fugitive emissions inventories, 136–50
 - all emissions are equal (assumption), 136–8
 - omissions and mischaracterizations, 138–50
- Inorganic salts in crude oils, 24
- Instrumental test methods, 222
- Intergovernmental Panel on Climate Change (IPCC):
 - accuracy/confidence limits, 172–4
 - activity data, 169–71
 - computer models, 154–5
 - data infrastructure, 172
 - direct measurement, 155–65
 - emission factors, 154
 - fugitive emissions, 153–4
 - indirect measurement, 165–8
 - production statistics, 171–2
 - simulators, 154–5
- International Bank for Reconstruction and Development, 37
- Investor's Business Daily*, 20
- ISO 14001 registration, 172
- Isomerization, 66–7
- Jordan (Amman/Zarqa) refinery, 144–9
- Kerosene, 19, 26, 39, 57
- Lake Charles Manufacturing Complex, US, 122
- Lawsuits:
 - Santa Barbara oil spill, 1969, 108–9
 - Santa Maria oil pumps, 103
- LDAR *see* leak detection and repair
- Lead:
 - gasoline, 36–7
 - poisoning, 37–8
 - wastewater, 185
- Leak detection and repair (LDAR), 150, 155, 214
- Leaks and fugitive air emissions, 198
- Legislation and Santa Barbara oil spill, 1969, 110–11
- Light Direction and Ranging (LIDAR), 167
- Liquefied petroleum gas (LPG), 29, 57, 72, 94
- Liquid waste streams and air pollution, 191
- Low-temperature thermal desorption, 100
- LPG *see* liquefied petroleum gas
- Lubricant manufacturing, 78
- Lubricating oils, 39, 78
- MACT *see* Maximum Achievable Control Technology
- Maintenance of asphalt plant, 201
- Maximum Achievable Control Technology (MACT), 221–2
- MDEA *see* methyldiethanolamine
- MEA *see* monoethanolamine
- Mercaptans, 181, 191
- Metals:
 - catalysts, 194
 - crude oils, 24
- Methyl isocyanate release (Bhopal, India), 150
- Methyl tertiary-butyl ether (MTBE), 38–9
- Methyldiethanolamine (MDEA), 206–7
- Minimal Risk Levels (MRLs), 239–42
- Monoethanolamine (MEA), 206
- Motor gasoline *see* gasoline
- Moving-bed catalytic cracking, 58

- MRLs *see* Minimal Risk Levels
MTBE *see* methyl tertiary-butyl ether
'Mud pumps', 3
Multi-jet ground flares, 88–90
- Napthenic components of crude oils,
20–1, 23
National Bureau of Standards, 20
National Environment Policy Act (NEPA),
110–11
National Pollution Discharge Elimination
System (NPDES), 186
Natural gas:
flaring, 210
prices, 210
processing, 14–15, 16–19
quality, 13–14
Natural gas liquids (NGLs), 16
NEPA *see* National Environment Policy
Act
NESHAP regulations, 26
New Source Performance Standards
(NSPS), 221–2
NGLs *see* natural gas liquids
Nitrogen in crude oils, 24
Nitrogen oxides (NO_x), 167, 179–80,
212, 222
Nitrogen rejection unit (NRU), 17
Nixon, Richard, 111
Non-hydrocarbons:
benzene, 24–6
crude oils, 23–4
hydrogen sulphide, 23
olefins, 24
pyophoric iron sulphide, 23
waste emissions, 24–6
Nonpoint sources of air emissions, 179–80
NPDES *see* National Pollution Discharge
Elimination System
NRU *see* nitrogen rejection unit
NSPS *see* New Source Performance
Standards
- Ocean environment and Santa Barbara oil
spill, 1969, 109
Octane number (antiknock), 26
Odors:
liquid waste, 191–2
'rotten eggs', 23
Oil:
pipelines, 13
sumps, 100
tanks, 95
see also crude oils
Oil-field operations, 2–13
Oil-in-water emulsions, 192
Oil–water separators, 186–7, 190–2
Oily sludge and coker feedstock, 207
Olefins, 23, 24
Organic compound analysers, 155–61
Orinoco tar sands, Venezuela, 2
Oxidation scrubbing processes, 218
Oxygen:
compounds in crude oil, 24
measurement, 222
Oxygenates, 38–9
- Paraffins:
components of crude oils, 20–1
hydrocarbons, 22
Particulate matter (PM), 179–80
PEL *see* Permissible Exposure limits
Permissible Exposure Limits (PEL),
228–30
Persistent, bioaccumulative and toxic
(PBT) chemicals, 151
Petroleum industry:
gas-fields, 2–13
gas plant processing, 13–19
history (United States), 19
oil-fields, 2–13
refining/refineries, 19–39
refining technologies, 39–95
Petroleum refining industry and air quality
standards, 218–20
Petroleum sumps, decommissioned, 100–1
Pipelines:
gas, 3
oil, 3, 13
Piping connectors in refineries, 200
Plains Exploration & Production
Company (PXP), 122, 136, 138,
172
PLC *see* pressure-relief controller
PM *see* particulate matter
Point sources of air emissions, 179

- Pollution Prevention Act, 1990, 150-1
- Polymerization, 68
- POTW *see* publicly owned treatment works
- Pressure relief:
 flare systems, 81-91
 valves, 181-2
- Pressure-relief controller (PLC), 215
- Pretreatment of crude oils, 45
- Process heaters, 79-80, 180
- Process wastewater, 26, 31-2
- Propane, 48
- Propylene, 24, 72
- Protocol for Equipment Leak Emission Estimates*, 6, 125
- Publicly owned treatment works (POTW), 186
- Pumps, piping and valves, 94-5
- PXP *see* Plains Exploration & Production Company
- Pyophoric iron sulphide, 23
- Recommended Exposure Limits (RELs), 232-3
- Record of decision (ROD), 187
- Refineries:
 air emissions, 179-85
 aromatic compounds, 24-5
 chemicals, 36, 36-8
 corrosion, 23, 49-50
 crude oil, 19-39
 effluent disposal, 188-92
 flaring, 210-12
 flow chart, 39-40
 Garyville, Louisiana, 19-20
 gasoline leaks, 144
 Gulf, Hooven, Ohio, 187
 Jordan, 144-9
 operations, 19-39
 piping connectors, 200
 processes, 42-3
 process heaters, 79-80, 180
 waste solids, 93-7
 wastewater, 185-93
- Refining technologies:
 alkylation, 69-71
 amine plants, 76
 asphalt production, 76-7
 blending, 77-8
 catalytic cracking, 57-8
 catalytic hydrotreating, 64-6
 catalytic reforming, 62-4
 classification, 39-45
 commercialization, 41
 cooling towers, 92-3
 corrosion, 49-50
 crude-oil distillation, 46-51
 fluid catalytic cracking, 58
 gas/air compressors and turbines, 93
 grease manufacturing, 78
 heat exchangers, coolers and process heaters, 79-80
 hydrocracking, 60-2
 hydrogen production, 75
 isomerization, 66-7
 lubricant manufacturing, 78
 marine, tank car, tank truck loading/unloading, 93-4
 moving-bed catalytic cracking, 58
 polymerization, 68
 pressure relief and flare systems, 81-91
 pretreatment, 41-2
 pumps, piping and valves, 94-5
 solvent dewaxing, 52
 solvent extraction, 51
 steam technologies, 80-1
 sweetening, 71-4
 tanks, 95
 thermal cracking, 53-7
 thermoform catalytic cracking, 59-60
 wastewater treatment, 91-2
 wax manufacturing, 78-9
- Regulation and Santa Barbara oil spill, 1969, 110-11
- RELs *see* Recommended Exposure Limits
- Residual water, 26, 33-4
- Retention ponds, 186, 189
- 'Rig' description, 3-6
- ROD *see* record of decision
- Roofs for oil-water separators, 192
- 'Rotten eggs' odor, 23
- Rupture discs, 85-6, 182
- Safety, health and environment (SHE), 197
- Safety valves, 85

- San Luis Obispo County Air Pollution Control standards:
best practices, 163–5
definitions, 161
- Santa Barbara oil spill, 1969, 107–12
cleanup, 110
crude oils, 109
ecological impact, 109–10
federal response, 107
incident, 107
lawsuits, 108–9
legislation, 110–11
ocean environment, 109
regulation, 110–11
responsibility, 107–8
wildlife, 110
- Santa Maria oil pumps, 99–112
agricultural land, 102
current/future of Santa Maria, 103–4
decommissioned petroleum pumps, 100–1
environmental health, 99–100
identification, 101–2
lawsuits, 103
map, 228
remediation, 102
total petroleum hydrocarbon removal, 100
- Santa Monica drinking water, 38
- SCAQMD *see* South Coast Air Quality Management District
- Schlumberger World Energy Alas, 2
- SCOT process, 180–1, 218
- Screening levels, 244–7
- Screening Value Range Method, 132–3
- Sewer lines, 192
- SHE *see* safety, health and environment (SHE)
- Shedgum Gas Plant, Saudi Aramco, 159–60
- Shine, B., 139, 141–4, 151
- SICs *see* standard industrial codes
- Sludge generation and spills, 203, 205
- Smokeless capacity in flaring, 212
- Solid waste treatment, 44
- Solvent dewaxing, 52
- Solvent extraction, 51
- ‘Sour’ crude oils, 20–1
- Sour-water stripping, 44
- South Coast Air Quality Management District (SCAQMD), 143
- Specific gravity, 20
- Spectrasyne company, 166, 168
- Spills:
cumulative, 205
sludge generation, 203
- Standard industrial codes (SICs), 122
- State Land Commission, California, 111
- Steam:
flaring, 213
generation, 80–1
- Steam traps:
fugitive air emissions, 199
hydrocarbon emissions, 149–50
malfunction, 199
spills and sludge generation, 203
- Steamcracking process, 54–5
- Sulfides, 191
- Sulfur:
crude oil, 20–1, 23
oil by-product, 194
recovery, 72, 216–18
removal from gas streams, 180
- Sulfur dioxide, 222
- Sulfur oxides (SO_x), 179–80, 212
- Sulfur-bearing waters, 193
- Sump identification in Santa Maria, 101–2
- ‘Sweet’ crude oils, 21
- Sweetening of crude oil, 23, 71–4
- Tail-gas treatment unit (TGTU), 72–3
- TAME *see* tertiary amyl methyl ether
- Tanks:
cleaning, 183
oil, 95
storage, 194
- TCC *see* thermofor catalytic cracking
- TCEQ *see* Texas Commission on Environmental Quality
- TEL *see* tetra-ethyl lead
- Tertiary amyl methyl ether (TAME), 38
- Testing programs for emissions, 218–24
- Tetra-ethyl lead (TEL), 36
- Tetra-methyl lead (TML), 36
- Texas Air Quality Study-2000, 150
- Texas Commission on Environmental Quality (TCEQ), 121–2, 139, 141

- Thermal cracking, 41–4, 52–7
Thermal radiation and flaring, 212
Thermoform catalytic cracking (TCC), 58, 59–60
Threshold Limit Value (TLV), 236
TLV *see* Threshold Limit Value
TML *see* tetra-methyl lead
TNMHCs *see* total non-methane hydrocarbons
Toluene, 25, 35, 38, 167
Total non-methane hydrocarbons (TNMHCs), 11
Total petroleum hydrocarbons (TPH), 99–100, 102
TOXCHEM+ modelling, 140
Toxic Release Inventory (TRI):
 critical assessment, 151–2
 Environmental Protection Agency reports, 121–3, 151–3
 goals, 151
 under-reporting, 2, 174
TPH *see* total petroleum hydrocarbons
Treatment:
 crude oils, 71–4
 processes for impurities, 44
TRI *see* Toxic Release Inventory
Turnarounds and air emissions, 183
TVA (toxic vapor analyzer) instrument, 158

Ultrasonic extraction, 100
Unit-specific Correlation Equation
 method, 132, 135–6
United Nations Environment Programme (UNEP), 153

Vacuum distillation, 47–8
Vacuum jets and air emissions, 184
Valves:
 flow control, 181
 leakage, 182
 pressure-relief, 182
 rupture discs, 182
Vapor pressure (environmental control), 26
Venturi-type ground flares, 88, 91
Vertical venturi flares, 89–90
Visbreaking process, 53–4

Volatile organic compounds (VOCs):
 cumulative spills, 205
 detectors, 156
 emissions from waste, 24–6
 emissions misreporting, 142, 174
 flaring, 212–14
 fugitive emissions,, 122, 139, 140, 144
 gas streams, 11
 hazardous air pollutant, 140
 low bias reporting, 136, 150
 pollution, 179
 Shine memorandum, 139, 144
 steam traps, 149
 storage tanks, 141, 185
 Waxman report, 1
Volatility of gasoline, 26

Waste solids, 193–7
Wastewater:
 acid sludge, 193
 air emissions, 187
 cleaner production, 185–93
 description, 185–7
 effluent disposal from refineries, 188–92
 pollution, 185–6
 process, 31–2
 solid waste, 187
 sulfur-bearing waters, 193
 treatment, 44, 91–2
Water injection ground flares, 88–9
Wax manufacturing, 78–9
Waxman report, 1999, 1–2, 121, 138–9, 151
WBO *see* World Bank Organization
Wellman–Land Process, 180–1
Wellman–Lord oxidation scrubbing process, 218
West Texas Intermediate (WTI) crude oil, 20
Wildlife and Santa Barbara oil spill, 1969, 110
WMO *see* World Meteorological Organization
World Bank Organization (WBO), 137–8
World Meteorological Organization (WMO), 153
WTI *see* West Texas Intermediate (WTI)

Xylene, 35, 38, 49, 174

Index

1995 Protocol for Equipment Leak
Estimates, 101-2

AAC *see* alkylammonium compound
ACC *see* acid copper chromate
Acetaldehyde, 204-5
ACGIH *see* American Conference of
Governmental Industrial Hygienists
Acid copper chromate (ACC), 21
Acid sulfite pulping, 184-5
ACQ *see* ammoniacal copper quat
Acrylonitrile (AN), 205-6
ACZA *see* ammoniacal copper zinc arsenate
Adsorption, 197-8
Aeration ponds, 50-1
AF&PA *see* American Forest & Paper
Association
Air emissions:
kilns, 32
pulp/paper mills, 179-260
wood-treatment, 55-6
Air pollution from wood-treatment:
emission factors, 85-115
emission sources, 84-5
fugitive emissions from treated wood,
87-98
introduction, 83
wood-waste burning, 115-32
Alkylammonium compound (AAC), 23
American Conference of Governmental
Industrial Hygienists (ACGIH),
208, 210, 216, 224
American Creosote Works, Florida,
66, 75-6
American Forest & Paper Association
(AF&PA), 202
American Petroleum Institute (API),
102, 107, 109
American Wood Preservers' Association
(AWPA):
air emissions, 99
carcinogenicity of preservatives, 83
Commodity Standards, 34

creosotes, 10, 27, 40
pentachlorophenol, 14
propiconazole, 23
vapor pressures, 66
water-borne preservatives, 20
wood treating chemicals, 135
Ammonia, 206-7
Ammoniacal copper arsenate, 40
Ammoniacal copper citrate (CC), 21
Ammoniacal copper quat (ACQ), 21, 40
Ammoniacal copper zinc arsenate
(ACZA), 20
AN *see* acrylonitrile
AP-42 *see* *Compilation of Air Pollution
Emission Factors*
API *see* American Petroleum Institute
Arkwood Inc. site, Omaha, 78-9
Arsenicals, inorganic, 18-20
Ashes and soot, dioxins, 128-9
Average emission factor method, 102-3
AWPA *see* American Wood Preservers'
Association

Baghouses, 195-7
Base catalysed decomposition (BCD), 77-8
BCD *see* base catalysed decomposition
Benzene, 32, 207-9
"Benzene-soluble fraction" (CTPVs), 12-13
Biological Oxygen Demand (BOD),
247, 263-4
Bis(tri-n-butyltin) oxide (TBTO), 23
Bleaching of pulp, 186-9
BOD *see* Biological Oxygen Demand
Boulton process, 31-2
Bush, George, W., 246

C&D *see* construction and demolition
*Calculation Workbook for Oil and Gas
Production Equipment Fugitive
Emissions*, 102
California Air Pollution Control Offices
Association (CAPCOA), 103,
105, 107

- CAPCOA *see* California Air Pollution Control Offices Association
- Catalytic reactors, 193
- CBA-A *see* copper azole type A
- CC *see* ammoniacal copper citrate
- CCA *see* chromated copper arsenate
- CDD *see* chlorodibenzo-*p*-dioxin
- CDDC *see* copper bis(dimethyldithiocarbamate)
- CDF *see* chlorodibenzofuran
- CEM *see* continuous emissions monitoring
- CERCLA *see* Comprehensive Environmental Response, Compensation and Liability Act
- CFB *see* circulating fluid bed
- Changing World Technologies (CWT), 153
- Chemicals:
 - preservation, 6–25
 - pulping, 182–3, 186, 202
 - wood-preserving, 1–26
- Chemimechanical pulping, 262
- Chemithermomechanical (CTMP) pulping, 262
- Chemrec AB, 268–70
- Chlorine, 210
- Chlorine dioxide, 209
- Chlorodibenzo-*p*-dioxin (CDD), 123
- Chlorodibenzofuran (CDF), 123
- Chloroform, 210–11
- Chlorothalonil, 22
- Chlorpyrifos (CPF), 22, 24
- Chromated copper arsenate (CCA), 19, 20–1, 27, 41, 51, 76, 84, 99
- Chromium (VI), 211–12
- Circulating fluid bed (CFB), 266–7
- Classified recycled fuel (REF), 266, 268
- Cleaner production through gasification, 145–53
- Cleaner production/pollution prevention (CP/P2), 156, 158–61
- Cleaning and chipping, 181
- Coal tar pitch volatiles (CTPVs), 92
- Coal-tar:
 - creosote, 6–8, 9–11, 52–3
 - description, 10
 - pitch, 10
- Coal-tar pitch volatiles (CTPVs), 13–14
- COE *see* CTPV
- COIs *see* constituents of interest
- Compilation of Air Pollution Emission Factors* (AP-42), 83, 85–8, 90, 92–6, 98–100, 103, 228–9
- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 63
- Constituents of interest (COIs), 65
- Construction and demolition (C&D), 44
- Continuous emissions monitoring (CEM), 122, 131
- Copper azole type A (CBA-A), 21
- Copper bis(dimethyldithiocarbamate) (CDDC), 21
- Copper naphthenate, 21–2
- Correlation Equation Method, 105–7
- CP/P2 *see* cleaner production/pollution prevention
- CPF *see* Chlorpyrifos
- Creosote, 27, 40, 65–6
- Creosote coal tar, 10–11, 46, 53
- Critchfield, David, 246
- Cross-draught gasifiers, 148
- Crossties, 2–3
- CTMP *see* chemithermomechanical
- CTPVs *see* “benzene-soluble fraction”
- CWT *see* Changing World Technologies
- Cyclones for removing particles, 191–2
- Destruction and removal efficiency (DRE), 121–2, 131, 146
- 4-5-Dichloro-2-N-octyl-isothiazolin-3-one, 25
- Diesel production, 152–3
- Dioxins:
 - ashes and soot, 128–9
 - emissions, 125–6, 127
 - properties, 213–14
 - wood-waste burning, 123–31
- Direct-contact evaporators, 194–6
- Douglas Fir, 2, 31, 40
- Down-draught (co-current) gasifier, 148
- DRE *see* destruction and removal efficiency (DRE)
- Drip pads and wood-treatment, 54–5, 56–64, 67, 138–9
- Drippage (kickback) and wood-treatment, 53–4, 139

- ECF *see* elemental chlorine-free
- EFB *see* electrified filter bed
- EFRT *see* external floating roof tank
- Electrified filter bed (EFB), 109
- Electrostatic precipitator (ESP), 197, 203
- Elemental chlorine-free (ECF) processes, 189–90, 247, 263
- Emergency Planning and Community Right-to-Know Act (EPCRA), 63
- Emission factors:
- air pollution from wood-treatment, 85–115
 - equipment, 105
 - natural gas-fired engines, 104
 - polycyclic aromatic hydrocarbons, 90–2
 - process, 100
 - pulp and paper, 230–45
 - pulp/paper mills, 228–9
 - treated wood production form pole plant, 91
 - wood manufacturing practices, 132–3
 - wood manufacturing sectors, 294–342
- Emissions:
- air pollution from wood-treatment, 84–5
 - constants, 89
 - dioxins, 125–6, 127
 - fugitive, 97
 - dust, 115
 - from spills, 114–15
 - kilns, 108–9
 - point source, 141–2
 - polycyclic aromatic hydrocarbons, 131–2
 - support equipment/piping components, 101–8
 - tank, 109–14
- EMS *see* environmental management system
- Environmental management system (EMS), 144, 156–9, 161–5
- Environmental policy checklist, 155
- EPCRA *see* Emergency Planning and Community Right-to-Know Act
- Equipment emission factors, 105
- ESP *see* electrostatic precipitator
- Ethylene glycol, 214–15
- European Union (EU) Directive on releases to water, 17
- External floating roof tank (EFRT), 110–13
- Finishing of pulp, 189
- Fischer, Franz, 153
- Fischer-Tropsch (FT) process, 153
- Fluidized-bed gasifier, 150–1
- Formaldehyde, 215–16
- Formic acid, 216–17
- Fort James Operating Company Inc., Pennington, 251–2
- Foster Wheeler, 266–8
- FT *see* Fischer-Tropsch
- Fugitive emissions, 97, 114–15, 139
- Furans and wood-waste burning, 123–31
- Gasification and cleaner production, 145–53
- Gasogene, 146
- Granite and track ballast, 3
- Graves, Lana, 251
- Green Profits*, 156
- “Green” wood, 29
- Handbook of Pollution Prevention Practices*, 261
- HAP *see* hazardous air pollutant
- Hardwoods, 2, 31, 34
- Hart Creosoting Co., Texas, 73–4
- Hazardous air pollutant (HAP):
- acetaldehyde, 204
 - ammonia, 207
 - chloroform, 211
 - dioxins, 213
 - formaldehyde, 215
 - hydrogen fluoride, 218
 - methanol, 220
 - phenol, 223
 - toluene, 226
 - Toxic Release Inventory, 201
- Heating values, 119–20
- Higgins Wood Preserving Co., Texas, 74–5
- Hydrochloric acid, 217–18
- Hydrogen fluoride, 218
- Hydrogen sulfide, 218–19

- IARC *see* International Agency for Research on Cancer
- IERs *see* initial environmental reviews
- IFRT *see* internal floating roof tank
- IGCC *see* integrated gasification combined cycle
- Ignition temperature, 119
- Incinerators, 192–3
- Incomplete combustion, 118
- Initial environmental reviews (IERs):
 audit forms, 271–90
 audit questionnaire, 165–78
 objectives, 161–5
- Inorganic arsenicals, 18–20
- Integrated gasification combined cycle (IGCC), 261, 270
- Internal floating roof tank (IFRT), 111–13
- Internal rate of return (IRR), 266
- International Agency for Research on Cancer (IARC), 11, 213, 224
- International Paper Co.:
 Jay, 229, 246–8
 Ticonderoga, 248–50
 Vicksburg, 253
- 3-Iodo-2-propynyl butyl carbamate (IPBC), 23
- IRR *see* internal rate of return
- Irving Pulp and Paper, St John mill, 250–1
- ISO standards:
 9000, 46, 48
 9001, 46–8
 14000, 159
 14001, 154
- Jasper Newsboy*, 73
- Kilns:
 drying, 31–3
 emissions, 108–9
 sticks, 45
- Kimberley-Clark Corp., Everett, 250
- Koppers Grenada Tie Treating Plant, Mississippi, 45, 54
- Koppers site, Morrisville, North Carolina, 77–8
- Koppers site, Oroville, California, 76–7
- Koppers Wood Treating Company, 69–73
- Kraege, Carol, 250
- Kraft pulping, 182, 183–4, 202–3, 263
- Legal and due diligence compliance checklist, 162–4
- Liquid petroleum gas (LPG), 14
- Liquid wastes from wood-treatment, 48–55
- Longview Fibre Co., Longview, 252–3
- LPG *see* liquid petroleum gas
- Manganese dioxide, 65
- Manual for Railway Engineering*, 4
- Martin, Roy, O., 95
- Mass emissions calculations, 93–8
- Mechanical pulping, 181–2, 186
- MEK *see* methyl ethyl ketone
- Methanol, 230
- Methyl ethyl ketone (MEK), 108
- Methyl isobutyl ketone (MIBK), 108
- Methyl mercaptan, 221
- MIBK *see* methyl isobutyl ketone
- Microturbines, 152
- Municipal solid waste (MSW), 44
- Municipal Solid Waste Factbook*, 179
- Naphthalene, 69
- NAPLs *see* non-aqueous-phase liquids
- Naptha treatment, 32–3
- National Emission Trends (NET), 201
- National Fire Protection Association (NFPA), 119
- National Institute of Occupational Safety and Health (NIOSH), 1, 11, 18, 92, 135, 142–4
- National Priorities List (NPL), 69
- Natural gas-fired engines emission factors, 104
- NET *see* National Emission Trends
- Neutral sulfite semi-chemical (NSSC) pulping, 182, 185–6
- NIOSH *see* National Institute of Occupational Safety and Health
- Non-aqueous-phase liquids (NAPLs), 65
- Non-pressure processes for wood preserving, 36–7
- Non-pressure treatments, 24
- NPL *see* National Priorities List
- NSSC *see* neutral sulfite semi-chemical

- Oak, 2, 34
- Occupational Safety and Health
Administration (OSHA), 1, 11, 17,
92, 209, 216, 251–2
- Odor control, 198
- Office of Air Quality Planning and
Standards (OAQPS), 86
- Open-core gasifiers, 149
- OSHA *see* Occupational Safety and Health
Administration
- Oxine copper (Copper-8-quinolinolate), 23
- PAC *see* Public Advisory Committee
- Packaging Corporation of America,
Tomahawk, 251
- PAH *see* polycyclic aromatic hydrocarbons
- Pandrol clips, 2, 4
- Particulate matter (PM), 108–9
- PCBs *see* polychlorinated biphenyls
- PCDDs *see* polychlorinated
dibenzodioxins
- PCDFs *see* polychlordibenzofurans
- PELs *see* permissible exposure limits
- Pentachlorophenol (PCP):
Arkwood Inc. site, 78–9
biodegradation, 51–2
carcinogenicity, 1
chemical delivery, 27
chemical spills, 121
emission sources, 84
fugitive emissions from treated
wood, 87
Koppers site, Oroville, 76
process emission factors, 101
properties, 14–19, 221–2
vapor pressure, 66, 70
- Permissible exposure limits (PELs),
12, 17
- Phenol, 223–4
- PM *see* particulate matter
- POHCs *see* polyorganic hydrocarbons
- Point source emissions, 141–2
- Pollution:
controls, 43–81
fate, 65–9
introduction, 43
transport, 65–9
waste sources, 43–56
- Pollution prevention:
pulp and paper industry
cleaner production, 265–71
initial environment reviews, 271–90
introduction, 261
P2 practices, 261–5
wood-preserving industry
best practice/technology, 137–45
cleaner production through
gasification, 145–54
environmental management
systems, 154–78
introduction, 135
- Polychlordibenzofurans (PCDFs), 15
- Polychlorinated biphenyls (PCBs), 14
- Polychlorinated dibenzodioxins
(PCDDs), 15, 213
- Polycyclic aromatic hydrocarbons (PAH):
chemical spills, 121
creosote coal tars, 84
destruction and removal efficiency, 131
emissions, 131–2
fugitive emissions
spills, 114
treated wood, 88–90, 92–4
incomplete combustion, 146
Koppers site, Oroville, 76
mass emission calculations, 96
preservation of wood, 6–12
toxic sludge, 45
vaporization, 67–9, 70
wood-waste burning, 115–16
- Polyorganic hydrocarbons
(POHCs), 121–2
- Preservation:
chemicals, 6–24
wood, 27–41
- President's Commission on Environmental
Quality, 246, 248
- Pressure processes for wood
preserving, 36–41
- Pressurized fluidized-bed
gasification, 151–2
- Process emission factors, 98–101, 100
- Propiconazole, 23
- Public Advisory Committee (PAC), 248
- Pulp and paper industry, pollution
prevention, 261–91

- Pulp/paper mills:
 air emissions
 case studies, 229, 246–53
 chemicals of concern, 202–27
 emission factors, 228–9, 230–45
 introduction, 179–80
 manufacturing technologies, 180–98
 pollution sources, 199–202
 regulations, 227–8
 Pulping processes, 181–9
- Radian Corporation, 131
- Rail:
 industry, 2
 profiles, 2
 tracks, 2
- RCRA *see* Resource Conservation and Recovery Act
- RDF *see* refuse-derived fuel
- Recommended exposure limits (RELs), 11–12, 17
- Record of decision (ROD), 69, 76–7, 78, 79, 80
- REF *see* classified recycled fuel
- Refuse-derived fuel (RDF), 266
- RELs *see* recommended exposure limits
- Resource Conservation and Recovery Act (RCRA), 45, 48, 51, 58, 63–4, 77, 121
- ROD *see* record of decision
- Screening Value Range Method, 103–5
- Seasoning of wood, 30
- Short-term exposure limit (STEL), 11–12
- Sludge reduction, 140–1
- Soda pulping, 182, 186
- Solid wastes from wood-treatment, 43–8
- Somerville Tie Plant, Texas, 32–3, 45–6, 49, 95
- Southern pine, 2
- Standards/retentions for chemicals and wood treatment, 35
- STEL *see* short-term exposure limit
- Stoichiometric combustion, 116
- Sulfite pulping, 164–5, 182
- Sulfur dioxide, 224–6
- Sulfuric acid, 224, 225
- Support equipment/piping components emissions, 101–8
- Tank emissions, 109–14
- “TANKS” software, 114
- TBTO *see* Bis(tri-n-butyltin) oxide
- TCDD *see* 2,3,7,8-tetra chlordibenzo-*p*-dioxin
- TCF *see* totally chlorine-free
- Tebucanazole (TEB), 24
- TEF *see* toxicity equivalency factor
- Teflon, 218
- 2,3,7,8-tetra chlordibenzo-*p*-dioxin (TCDD), 213
- Threshold limit values (TLVs), 92, 144
- Tie plates, 3–4
- Tie strength properties, 4–6
- Timber preparation, 29–33
- Time-weighted average (TWA), 11–12
- TLVs *see* threshold limit values
- Toluene, 226–7
- Totally chlorine-free pulp (TCF), 189, 190
- Toxicity equivalency factor (TEF), 123, 213
- Toxics Release Inventory (TRI), 92, 179, 201
- Track ballast, 3
- TRI *see* Toxics Release Inventory
- Tropsch, Hans, 153
- TWA *see* time-weighted average
- UNEP *see* United Nations Environment Programme
- Unit-Specific Correlation Equation Method, 107–8
- United Creosoting Site, Conroe, Texas, 79–80
- United Kingdom (UK):
 Pesticide Safety Directorate, 17
 Pollution Prevention and Control Regulations, 17–18
- United Nations Environment Programme (UNEP), 17
- United States Environmental Protection Agency (US EPA):
1995 Protocol for Equipment Leak Estimates, 101–2

- acetaldehyde, 204
- air emissions, 83
- Air Pollution Emission Factors* (AP-42), 83, 85–8, 90, 92–6, 98–100
- American Creosote Works, 76–7
- ammonia, 207
- Arkwood Inc. site, Omaha, 79
- average emission factor method, 102
- benzene, 207
- carcinogenicity, 135
- carcinogens, 1
- case studies, 69
- chlorine, 190, 210
- chlorine dioxide, 209
- chloroform, 211
- “cluster rule”, 190
- coal-tar creosote, 11
- creosote, 7, 10
- dioxins/furans, 124
- drip pads, 62, 64
- ethylene glycol, 215
- formaldehyde, 215
- formic acid, 216
- fugitive emissions from spills, 114
- Hart Creosoting Co., 73
- hazardous air pollutants, 203
- hydrochloric acid, 217–18
- hydrogen fluoride, 218
- hydrogen sulfide, 219
- Koppers site, Oroville, California, 76–7
- Koppers Wood-treating Co.,
 - Carbondale, 71
- methanol, 220
- methyl mercaptan, 221
- Municipal Solid Waste Factbook*, 179
- pentachlorophenol, 15–18, 222
- phenol, 223
- polycyclic aromatic hydrocarbons, 12
- pulp/paper mills and odor control, 198
- Sector Notebook*, 169
- sulfur dioxide, 225
- sulfuric acid, 224
- Superfund sites, 136
- tank emissions, 110, 114
- toluene, 226
- Unit-Specific Correlation Equation Method, 107
- wood-preserving processes, 54, 56–9
- United States (US) Forest Service, 67, 93
- Up-draught (counter-current) gasifiers, 147
- Vapor pressures, 66–9, 70
- Volatile organic compounds (VOCs):
 - Air Pollution Emission Factors*, 83
 - acetaldehyde, 204
 - acrylonitrile, 205
 - fugitive emissions
 - spills, 114
 - treated wood, 87–8, 104–5, 108
 - process emission factors, 98, 104–5, 108
 - pulp/paper sector, 201–2
- Waste reduction/pollution control/
 - sustainability in paper industry, 189–98
- Waste sources and wood-waste burning, 115–23
- Wastewater treatment, 50–1
- Water-borne preservatives, 20
- Water-repellent treatments, 23
- WBO *see* World Bank Organization
- Wet scrubbers, 193–4
- WHO *see* World Health Organization
- Wood:
 - drying, 31
 - growth rings, 34
 - harvesting, 180–1
 - manufacturing practices and emission factors, 132–3
 - paper manufacturing, 180
 - preservation technology
 - general facility overview, 27–9
 - introduction, 27
 - maximum temperature for preservatives, 40
 - process summary, 38–9
 - timber preparation, 29–33
 - wood treating, 33–41
 - products, 2–6
 - properties, 33–4
 - seasoning, 30
 - standards, 35
 - treating, 33–41
 - types, 2–6
- Wood manufacturing sectors, emission factors, 294–342

- Wood-preservation:
 chemicals, 1–6, 6–25
 industry and pollution
 prevention, 135–78
- Wood-treatment:
 air emissions, 55–6
 drip pads, 56–64
 drillage, 53–4, 139
 liquid waste, 48–55
 plant layout, 27–8
 preservation, 33–41
 processes, 38–9
 solid waste, 43–8
- Wood-waste burning:
 dioxins and furans, 123–31
 polycyclic aromatic hydrocarbons,
 131–2
 waste sources, 115–23
- World Bank Organization (WBO),
 15–16, 263–4
- World Health Organization (WHO), 14–15
- Xylene, 33
- Zinc naphthenate, 20–3

Index

- A**
- ACC *see* Army Chemical Corps
- ACGIH *see* American Conference of Governmental Industrial Hygienists
- Agent Orange:
- aircraft accidents, 263
 - chemical composition, 261–2
 - government response
 - United States, 266
 - Vietnam, 265–6
 - health effects, 264
 - introduction, 261
 - Korean War, 267
 - litigation, 266–7
 - name, 261
 - program termination, 263–4
 - Vietnam War, 262–3
 - World Health Organization, 262
- Agent Purple, 261
- Agrichemicals in Surface Water and Birth Defects in the United States*, 227
- Air emissions:
- ammonium nitrate, 27–9
 - ammonium phosphates, 32
 - nitric acid, 27–8
 - normal superphosphates, 32–3
 - pesticides
 - formulations, 33–4
 - packaging/repackaging, 33–4
 - phosphoric acid, 31–2
 - pollution prevention, 70, 75–6
 - processes, 26
 - synthetic ammonia, 27
 - triple superphosphates, 33
 - urea, 30–1
- Aldicarb sulfoxide (ASO), 276–7
- Aluminium fluoride:
- JPMC, 25
 - production, 45
 - properties, 47
 - uses, 47
- American Conference of Governmental Industrial Hygienists (ACGIH), 235
- Ammonia:
- manufacture, 40
 - plant, 12
 - pollution prevention, 79
 - production, 50
 - scrubbing, 54–6
 - synthetic, 2, 5, 13–14, 27, 37
- Ammonium nitrate, 2–3, 5, 17–19, 23, 27–9
- Ammonium phosphates, 3, 6–7, 20–1, 32
- Ammonium sulfate, 3, 6
- Applications of products, 82–131
- Aqaba Special Economic Zone (ASEZ), 56–7
- Army Chemical Corps (ACC), 261, 264
- ASEZ *see* Aqaba Special Economic Zone
- ASO *see* aldicarb sulfoxide
- Atrazine:
- alternatives, 229–30
 - breakdown products
 - 'chlorotriazines', 220
 - de-ethylatrazine, 218
 - de-isopropyl atrazine, 218
 - degradates, 218–19
 - di-aminochlorotriazine, 219
 - hydroxyatrazine, 218
 - N-nitrosoatrazine, 219
 - chemical properties, 216–18
 - environment, 217–18
 - EPA, 215
 - health effects
 - endocrine disruption, 225–6
 - reproduction, 227
 - triazine herbicide manufacture, 226
 - introduction, 215
 - names, 216–17
 - properties, 217
 - regulations, 215–16
 - removal
 - granular activated carbon, 228–9

- Atrazine: (*Continued*)
 introduction, 228
 restricted use pesticide, 215
 Syngenta Monitoring Program, 219,
 220–4
 United States usage, 215–16
 water contamination, 219–20
- Auto-ignition temperatures, 132–214
- B**
- Bald Eagles on Catalina Island, California
 and DDT, 253
- Bill and Melinda Gates Foundation, 265
- Biological pesticides (biopesticides), 9
- C**
- Cancer Incidence among Triazine Herbicide
 Manufacturing Workers*, 226
- Carcinogenic ingredients of products, 82–131
- Carson, Rachel, 249, 269
- 'Chlorotriazines', 220
- Chrysanthemums, 9
- Community water systems (CWS), 219
- Conditions to avoid (for products), 132–214
- CWS *see* community water systems
- D**
- 2, 4-D *see* 2,4-dichlorophenoxyacetic acid
- DAP *see* diammonium phosphate
- DBCP *see* dibromochloropropane
- DCP *see* dichloropropene
- DDD (dichlorodiphenylethane), 247–8, 254
- DDE (dichlorodiphenyltrichloroethylene),
 247–8, 251, 253–4
- DDT (dichlorodiphenyltrichloroethane):
 Bald Eagles on Catalina Island, 253
 chemistry, 248
 China, 257
 current use, 255–7
 decline, 249–50
 distribution and transport, 250–1
 environmental fate, 250–1
 EPA, 249, 252–3, 255
 health effects
 insects, 253
 metabolism in humans, 253–4
 history, 247–8
 human exposure, 251–2
 India, 257
 introduction, 247
- Malaria controversy, 255–6
- Montrose Chemical Corporation, 252–3
- National Priorities List, 252, 253
- North Korea, 257
- Palos Verdes Shelf, 252–3
- Peregrine Falcons in Southern California
 Bight, 253
- production and uses, 247–8
- vector control, 255–7
- wildlife, 252
- World Health Organization, 247, 249, 253
- De-ethylatrazine (DEA), 218–19, 220
- De-isopropyl atrazine (DIA), 218–19, 220
- DEA *see* de-ethylatrazine
- Department of Veteran Affairs (VA), 262,
 264
- Di-aminochlorotriazine (DIC), 219
- DIA *see* de-isopropyl atrazine
- Diacambia (alternative to atrazine), 230
- Diammonium phosphate (DAP), 4, 6–7,
 20–1, 24, 46–7
- Dibromochloropropane:
 chemistry, 241
 environment, 240
 EPA, 242
 health effects, 241–2
 TCP, 239–41
 treatment, 242–3
 usage and regulation, 240
- DIC *see* di-aminochlorotriazine
- Dichlorodiphenylethane *see* DDD
- Dichlorodiphenyltrichloroethane *see* DDT
- Dichlorodiphenyltrichloroethylene *see* DDE
- 2,4-Dichlorophenoxyacetic acid (2, 4-D),
 261
- Dichloropropene (DCP), 237–9
- Dioxin *see* 2,3,7,8-tetrachlorodibenzo-p-
 dioxin
- Dole Food Company, 241
- Dorr-Oliver slurry granulation process, 22
- DOW AgroSciences, 237
- DOW Chemical Company, 242, 266
- E**
- EDPM (ethylene-propylene-diene) monomer,
 65
- EMSs *see* Environmental Management
 Systems

- ENECE *see* United Nations Economic Commissions for Europe
- Environmental aspects of pollution:
 ammonia scrubbing, 54–6
 control technologies, 53–4
 target pollution loads, 53–4
 waste, 53
- Environmental Management Systems (EMSs), 25, 44, 67
- Environmental Protection Agency (EPA):
 agricultural chemicals, 1
 atrazine, 215, 220–1, 225–6, 228
 DBCP, 242
 DDT, 249, 252–3, 255
 pesticide residues in foods, 269–71
 pesticide status, 281, 282–305
 screening levels, 281, 282–305
 TCP, 236–7
- EPA *see* Environmental Protection Agency
- EPDM (ethylene-propylene-diene) monomer, 65
- Eshidiya Mining Operations, 67–8
- Essential nutrients for plant life, 1
- European Union (EU):
 atrazine, 216
 DCP-containing soil fumigants, 237
- Explosive limits in air, 132–214
- F**
- FDA *see* Food and Drug Administration
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 10, 249
- Federal Organic Foods Protection Act, 1990 (FOFPA), 273
- Fertilizers:
 mixing only, 4
 nitrogenous, 2–3, 11–12, 13–19
 phosphatic, 3–4, 20–4
- FIFRA *see* Federal Insecticide, Fungicide, and Rodenticide Act
- Flash point temperatures, 132–214
- FOFPA *see* Federal Organic Foods Protection Act, 1990
- Food and crop enhancement, 1
- Food and Drug Administration (FDA):
 ‘dirty dozen’, 274–5
 pesticide monitoring program, 271
 pesticide residues in food, 269, 274
- Food Quality Protection Act (FQWA), 270, 272–3
- FQWA *see* Food Quality Protection Act
- Fungicides, 9
- G**
- GAC *see* granular activated carbon
- Genetically modified plants, 9
- Granular activated carbon (GAC):
 atrazine, 228–9
 TCP, 243
- Granular TSP, 47
- Granulation plant, 45
- Gypsum (calcium sulfate), 20
- H**
- HA *see* hydroxyatrazine
- Hazardous decomposition products, 132–214
- Health hazards of products, 82–131
- Herbicides, 8
- Hydroxyatrazine (HA), 218
- I**
- InLine (1, 3-dichloropropene and chloropicrin), 237
- Insecticides, 8–9
- Ion-exchange technologies, 66–7
- ISO 14001, 25, 67
- J**
- Jordan Phosphate Mines Co (JPMC), Aqaba:
 aluminium fluoride, 45, 47
 case study, 25–52
 diammonium phosphate, 46–7
 energy efficiency and sulfuric acid, 61–2
 environmental aspects, 53–6
 granulation plant, 45
 high-cost options, 66–8
 low-cost options, 65
 phosphoric acid, 44–5, 49–50
 pollution prevention, 56–7, 68–79
 recommendations, 57–9
 source reduction, 59
 steam losses and heat recovery, 62–4
 sulfuric acid, 44, 46, 48–50
 utility plant, 45–6
 water management, 60–1

- K**
 Kelthane (aciride dicofol), 255
- L**
 LH *see* luteinizing hormone
 Luteinizing hormone (LH), 225
- M**
 MacLennon, P.A., 226
 Malaria controversy and DDT, 255–7
 MAP *see* monoammonium phosphate
 Material handling facilities, 45–6
 Materials to avoid (for products), 132–214
 Maximum residue limits (MRLs), 269
 Mesotrione (alternative to atrazine), 230
 Methanol manufacture, 42
 Monoammonium phosphate (MAP), 4, 6–7, 20–1
 Montrose Chemical Corporation, 252–3
 Montrose Settlements Restoration Program (MSRP), 253
 MRLs *see* maximum residue limits
 MSRP *see* Montrose Settlements Restoration Program
- N**
 Names of products, 82–131, 132–214
 National List of Allowed and Prohibited Substances (NLAPS), 273
 National Priorities List (NPL), 252, 253
 National Toxicology Program (NTP), 235
 National Water Quality Assessment (NAWQA), 227
New York Times, 221
 NFPA ratings for products, 132–214
 NHL *see* non-Hodgkin's lymphoma
 Nitrate compounds manufacture, 41–2
 Nitric acid:
 air emissions, 27–8
 nitrogenous fertilizers, 5
 production, 2, 11, 15–16
 uses, 2
 Nitrogen-phosphorus-potassium (NPK)
 mixes, 4, 7, 46
 Nitrogenous fertilizers:
 classification, 2–3, 5–6
 manufacture
 ammonium nitrate, 11–12, 17–19
 nitric acid, 11, 15–16
 processes, 11
 synthetic ammonia, 13–14
 urea, 11–12, 17–19
 products, 5–6
 N-Nitrosoatrazine, 219
 NLAPS *see* National List of Allowed and Prohibited Substances
 Non-Hodgkin's lymphoma (NHL), 254
 Normal superphosphates (NSPs), 4, 7, 21–2, 32–3
 NPK *see* nitrogen-phosphorus-potassium
 NPL *see* National Priorities List (NPL)
 NSP *see* normal superphosphate
 NTP *see* National Toxicology Program
- O**
 Operation Ranch Hand, 261
 Organic foods:
 FOFPA, 273
 pesticides, 273–4
 Organic mercury poisoning, 278
 'Organic plan', 273
- P**
 P2 *see* pollution prevention
 Palos Verdes Shelf (PVS), Los Angeles, 252
 PAP *see* phosphoric acid plant
 Parathion poisoning, 278
 Peregrine Falcons in Southern California Bight, 253
 Pesticide data program (PDP), 270–1
 Pesticide residue in foods:
 acute exposures
 aldicarb, 276–7
 contamination variability, 277
 poisoning epidemics, 277–8
 'dirty dozen', 274–5
 federal monitoring
 EPA tolerances, 269–70
 FDA pesticide monitoring, 271–2
 FDA total diet study, 271–2
 USDA, 270–1
 Food Quality Protection Act, 272–3
 introduction, 269
 measurement, 275–6
 modification during post-harvest, 272
 organic foods, 273–4

- surveillance of residue contamination, 269–70
- Pesticides:**
 - biological, 9
 - common, 8
 - formulations, 10
 - fungicides, 9
 - genetically modified plants, 9
 - herbicides, 8
 - insecticides, 8–9
 - packaging/repackaging, 33–4
 - plant growth regulators, 9
 - sex attractants, 9
 - solid/hazardous/residual wastes, 39–40
- Phosphatic fertilizers:**
 - classification, 3–4
 - manufacture
 - ammonium phosphate, 20–1
 - normal super phosphate, 21–2
 - triple superphosphate, 22
 - wet process, 20
 - products, 6–7
- Phosphogypsum slurry (calcium sulfate), 49**
- Phosphoric acid:**
 - air emission sources, 31–2
 - chemistry, 49
 - manufacture, 23, 40–1
 - phosphatic fertilizers, 3, 6, 23
 - production, 49–50
- Phosphoric acid plant (PAP), 23, 44**
- Phosphorus pentoxide, 3–4, 23, 47**
- Plants:**
 - essential nutrients, 1
 - growth regulators, 9
- Poisoning epidemics, 277–8**
- Pollution:**
 - case study, 25–51
 - desalination, 56–7
 - environmental aspects, 53
 - sources, 25
- Pollution Prevention Act 1990, 68**
- Pollution prevention (P2):**
 - aerosol container leak testing, 74
 - air emissions, 70, 75–6
 - ammonia converter retrofit, 79
 - best management, 69
 - carbon dioxide removal, 79
 - cleaning
 - bulk tank, 72–4
 - floor/wall equipment, 76–7
 - laboratory equipment, 74–5
 - leaks and spills, 77
 - shipping container/drum, 70–2
 - containers, 70
 - containment pad in loading/unloading area, 78–9
 - feed-gas saturator, 79
 - good housekeeping, 69
 - hydrogen recovery from purge gas, 79
 - introduction, 68
 - microprill formation, 76
 - off-specification products, 70
 - practices, 69–79
 - spills and areas washdowns, 69
 - storage tanks, 75
 - stormwater run-off, 77–8
 - technology adaptations, 69
 - waste minimization, 69
 - wastewater streams, 70
- Powdered activated carbon (PAC), 238**
- PRL *see* prolactin hormone**
- Product names, 82–131, 132–214**
- Prolactin hormone (PRL), 225**
- PVS *see* Palos Verdes Shelf**
- Pyrethroids, 9**
- R**
 - Reproduction and atrazine, 227**
 - Residual acute exposure (RAE), 277**
 - Restricted use pesticide (RUP) and atrazine, 215**
- S**
 - S-metachlor (alternative to atrazine), 230**
 - SAP *see* sulfuric acid plant**
 - Sex attractants (pesticides), 9**
 - Shell D-D fumigant, 238–9**
 - Silent Spring*, 249, 269**
 - Simazine (competitor to atrazine), 230–1**
 - Single or normal phosphate (SSP), 47**
 - Sodium fluoride poisoning, 278**
 - Solid/hazardous/residual wastes:**
 - fertilizers, 37–9
 - pesticides, 39–40
 - SSP *see* single or normal phosphate**
 - Steam losses and heat recovery, 62–4**

- Sulfuric acid:
 energy efficiency, 61–2
 JPMC, 25
 manufacture, 43
 production, 46, 48–9
 storage, 51
- Sulfuric acid plant (SAP), 44
- Syngenta Atrazine Monitoring Program (AMP), 219, 220–4
- Syngenta Corporation, Switzerland, 220
- Synonyms of products, 82–131
- Synthetic ammonia, 2, 5, 13–14, 27
- T**
- 2,4,5-T *see* 2,4,5-trichlorophenoxyacetic acid
- TCDD *see* 2,3,7,8-tetrachlorodibenzo-p-dioxin
- TCP *see* 1, 2, 3-trichloropropane
- TCP–DCP link, 237–9
- Telone C-17 (1, 3-dichloropropene), 237
- Telone II (1, 3-dichloropropene), 237
- Terbutylazine (alternative to atrazine), 230
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD), 261–2
- Toxic and dangerous properties of chemicals:
 applications, 82–131
 auto-ignition temperature, 132–214
 carcinogenic ingredients, 82–131
 conditions to avoid, 132–214
 explosive limits in air, 132–214
 flash point temperature, 132–214
 hazardous decomposition products, 132–214
 health hazards, 82–131
 materials to avoid, 132–214
 NFPA ratings, 132–214
 product names, 82–131, 132–214
 synonyms, 82–131
- Triazine herbicide manufacture, 226
- 2,4,5-Trichlorophenoxyacetic acid (2, 4, 5-T), 261, 264
- 1, 2, 3-Trichloropropane (TCP):
 atmospheric concentrations, 237
 chemistry, 233–4
 DCP link, 237–9
 dibromochloropropane, 239–42
 distribution, 233–4
 Environmental Protection Agency, 236–7
 environmental transport, 233–4
 groundwater contamination
 Burbank, California, 242
 Oahu, Hawaii, 239
 Shafter & Merced, California, 239
 regulations and standards, 236–7
 toxicology
 cancer effects, 235
 exposure, 234–5
 metabolism, 236
 non-cancer effects, 235–6
 transformation, 233–4
 treatment and remedial technologies
 ex situ, 243–4
 in situ, 242–3
- Triple superphosphate (TSP), 4, 7, 22–4, 33, 47
- TSP *see* triple superphosphate
- U**
- United Nations Children's Fund (UNICEF), 265
- United Nations Development Fund (UNDP), 265
- United Nations Economic Commissions for Europe (UNECE), 255
- United Nations Stockholm Convention on Persistent Organic Pollutants, 250, 255, 257
- United States Fish and Wildlife Service, 252
- United States Geological Survey (USGS), 227
- Urea (carbamide or carbonyl diamide), 3, 6, 17–19, 23, 30–1
- US Department of Agriculture (USDA):
 'dirty dozen', 274–5
 NLAPS, 273
 Pesticide data program, 270–1
 pesticide residue in foods, 269
- US EPA *see* EPA
- USAID, 57, 68
- USGS *see* United States Geological Survey
- Utility plant, 45–6

V

Vietnam Association for Victims of Agent Orange/Dioxin v. DOW Chemical Co., 266–7

Vietnam War and Agent Orange, 262–3

W

WAJ *see* Water Authority of Jordan

Wastewater and manufacturing:

fertilizers, 35

pesticides, 36–7

phosphatic fertilizers, 35–6

Water Authority of Jordan (WAJ), 57

Wet process for phosphatic fertilizers, 20, 23

WHO *see* World Health Organization

Winchester, P., 227

World Bank, 53

World Health Organization (WHO):

Agent Orange, 262

DDT, 247, 249, 253

TCP, 234