Corrections to Static Book

<u>Page 18 figure 2-5</u>: delete "acetone" from figure (I can't do this electronically)

<u>Page 41 Note 1 ninth line</u>: delete second period after "Figure 2-6.5"

<u>Page 43 Section 2-6.6</u>: replace existing text with:

2-6.6 Surface Streamer. This is the author's classification for a large surface discharge observed on charged liquids, particularly during road tanker filling, typically appearing as an approximately 2 ft (0.6 m) long flash and accompanied by a crackling sound. It is not described in current electrostatic texts but was commonly discussed in US publications of the early 1960s, being referred to as the "go-devil" [61] or as "severe sparking" [148]. Its effective energy is unknown, but should be significantly greater than that of the brush discharge; its similarity to the bulking brush discharge suggests a similar effective energy of the order 10-20 mJ. High charge densities from an upstream filter with insufficient residence time (5-3.5) plus a liquid with very low conductivity might produce this wall-to-liquid surface discharge. The initiating mechanism in most cases probably requires transient convection of abnormally high charge densities to the liquid surface.

Plate 7 : Surface Streamer Discharge in Stirred Reactor

Plate 7 shows one of a series of surface streamer discharges photographed in a 10 ft (3.05 m) diameter stirred reactor during an inert gas sparging step. The stirrer shaft diameter (4 inch or 10 cm) gives an indication of scale. The discharges were all of similar size and initiated at any of four vertical baffles located at 90 degree intervals around the reactor wall. The baffles were 19 ft (5.8 m) high, 10 in (25 cm) wide and 2 in (5 cm) thick, being spaced 2 in (5 cm) from the wall. Field intensification by the baffles caused the discharges to initiate at these locations around the liquid surface, while there were no visible initiations or terminations at the stirrer shaft. The reactor contained a slurry of solids in a light, non-polar, non-conductive hydrocarbon. Plate 7 shows the potential for formation of unusually large and energetic static discharges under conditions that convect large charge densities to the liquid surface. Stirred slurries in non-conductive liquids are known to generate high charge densities (5-4.5.2). In this case, convection of abnormally large charge densities to the liquid surface was presumably assisted by interfacial charge carried by the rising gas bubbles (5-4.1.2). In the example discussed here, the reactor was operated outside the flammable region at all times and the observed static phenomena did not represent a hazard.

Page 63 Second Paragraph 1st line: replace "of" with "for"

Page 122 First Paragraph 8th line from bottom: replace "For example," with: "Owing to charge stratification,"

Page 126 Fourth line: replace "methane" with "methyl butane (isopentane)"

Page 136 Seventh line: replace "fiber pack" with "fiber drum"

Page 139 Section 5-4.7 Second line: replace "All" with "Unburied"

Page 156 Section 5-8.4.2 Sixth line: Begin sentence with capital "N"

Page 159 Fifth line: delete reference "[50]"

Page 169 Sixth line: replace "extinguishing" with "blanketing"

Page 171 Section 6-1.2.1 end of 1st paragraph: may need to adjust page reference 235

Page 180 Equation 6-2.1.1.f: change "r" under equation to "rho" (where ρ = density)

Page 183 Section 6-3.1 Fifth line: replace "number" with "frequency"

Page 191 Second Paragraph 3rd line: replace "were" with "was"

Page 197 Section 6-5.1 1st line: replace "In early 1998" with "In November 1997"

Page 206 Second Paragraph First line: Change "may be applied" to "might apply". Also in Table A-4-1.3a, delete odd symbols around "Points"

Page 213 Seventh line: change reference "[8]" to "[9]"

Appendix B Flammability Data Table: Correct as shown in red

<u>Flammability Data for Gases and Vapors</u>
<u>In dry air at 1 atm, 25°C except where indicated</u>
<u>See footnotes for explanations of symbols</u>

Gas/Vapor	LMIE = G	Stoi	Opt = Co	LFL	UFL	Su	LOC in N_2
	(mJ)	(vol%)	(vol%)	(vol%)	(vol%)	(cm/s)	(vol%)
acetaldehyde	0.13(a)	7.73	-	4.0	57.0		
acetone	0.19(a)	4.97	-	2.6	12.8	54	11.5
acetone (in oxygen)	0.0024		-	2.5	60		n/a
acetylene	0.017	7.72	8.5	2.5	100	166	0
acetylene (in oxygen)	0.0002	28.6	40	2.5	100	1140	n/a
acetylene (decomp @ 1 atm)	10^3-10^5	100	100	n/a	100		0
acetylene (decomp @ 2 atm)	10^2 –10^3	100	100	n/a	100		0
acrolein	0.13	5.64	-	2.8	31	66	
acrylonitrile	0.16	5.29	9.0	3.0	17.0	50	
allyl chloride	0.77(b)		-	2.9	11.1		
ammonia	680	21.8	-	15	28		
benzene	0.20	2.72	4.7	1.2	7.8	48	11.4
1,3 butadiene	0.13	3.67	5.2	2.0	12	68	10.5
n-butane	0.25	3.12	4.7	1.6	8.4	45	12
n-butane (in oxygen)	0.009	13.3	-	1.6	49		n/a
n-butyl chloride	1.24(b)	3.37	-	1.8	10.1		
carbon disulfide	0.009	6.53	7.8	1.0	50.0	58	5
cyclohexane	0.22	2.27	3.8	1.3	8.0	46	
cyclopentadiene	0.17(a)		-			46	
cyclopentane	0.24(a)	2.71	-	1.5		44	
cyclopropane	0.17	4.44	6.3	2.4	10.4	56	11.5
cyclopropane (in oxygen)	0.001		17	2.5	60		n/a
dichlorosilane	0.015	17.4	-	4.7	96		
diethyl ether	0.19	3.37	5.1	1.9	36	47	10.5
diethyl ether (in oxygen)	0.0012		14	2.0	82		n/a
diisobutylene	0.23(a)		-	1.1	6.0		
diisopropyl ether	0.23(a)		-	1.4	7.9		
dimethoxymethane (methylal)	0.12(a)		-	2.2	13.8		
2,2-dimethylbutane	0.25	2.16	3.4	1.2	7.0	42	

Gas/Vapor	LMIE = G	Stoi	Opt = Co	LFL	UFL	Su	LOC in N₂
dimethyl ether	**0.15(a)**		-	3.4	27.0	54	
dimethyl sulfide	**0.48(b)**		-	2.2	19.7		
di-t-butyl peroxide	0.1		-		100		0
ethane	**0.23**	5.64	6.5	3.0	12.5	47	11
ethane (in oxygen)	0.0019	22.2	17	3.0	66		n/a
ethanol	**0.23(a)**	6.53	-	3.3	19		10.5
ethyl acetate	**0.23(a)**	4.02	-	2.0	11.5	38	
ethyl acrylate	**0.18(a)**		-	1.4	14		8
ethylamine	**0.19(a)**	5.28	-	3.5	14		
ethylene	0.084	6.53	7.5	2.7	36	80	10
ethylene (in oxygen)	0.00094	25.0	22.5	3.0	80		n/a
ethyleneimine	**0.11(a)**		-	3.6	46	46	
ethylene oxide	0.065	7.72	10.8	3.0	100	108	0
ethylene oxide (decomp)	~1500	100	n/a	n/a	100		0
furan	**0.14(a)**	4.44	-	2.3	14.3		
n-heptane	0.24	1.87	3.4	1.05	6.7	46	11.5
n-hexane	0.24	2.16	3.8	1.1	7.5	46	12
n-hexane (in oxygen)	0.006	9.52	-	1.2	52*		n/a
hydrogen	0.016	29.5	28	5±1	75	312	5
hydrogen (in oxygen)	0.0012	66.7	-	4.0	94	1400	n/a
hydrogen (in nitric oxide)	8.7	50.0	-				n/a
hydrogen sulfide	0.068		-	4.0	44		7.5
isooctane	**0.25(a)**	1.65	-	0.95	6.0	41	
isopropyl alcohol	**0.21(a)**	4.44	-	2.0	12.7	41	
isopropyl chloride	**1.08(b)**		-	2.8	10.7		
isopropylamine	**0.23(a)**		-			31	
methane	0.21	9.47	8.5	5.0	15.0	40	12
methane (in oxygen)	0.0027	33.3	23	5.1	61	450	n/a
methane (in nitric oxide)	8.7		-				n/a
methanol	0.14	12.24	14.7	6.0	36.0	56	10
methylacetylene	0.11	4.98	6.5	1.7			
methyl acrylate	**0.18(a)**		-	2.8	25		8.7
methylene chloride	>1000		-	14	22		19
methylene chloride (in oxygen)	0.137		-	11.7	68		n/a
methyl ethyl ketone	**0.21(a)**	3.66	-	2.0	12.0		11
methyl butane (isopentane)	0.21	2.55	3.8	1.4	7.6	43	12
methyl cyclohexane	0.27	1.96	3.5	1.2	6.7	44	
methyl formate	**0.13(a)**		-	4.5	23		
n-pentane	0.24	2.55	3.3	1.5	7.8	46	12
2-methyl pentene	0.18	2.72	4.4			47	

Gas/Vapor	LMIE = G	Stoi	Opt = Co	LFL	UFL	Su	LOC in N$_2$
propadiene	0.087(a)		-				
propane	0.24	4.02	5.2	2.1	9.5	46	11.5
propane (in oxygen)	0.0021	16.7	15				n/a
propionaldehyde	0.18(a)		-	2.6	17	58	
n-propyl chloride	1.08(b)		-	2.6	11.1		
propylene	0.18(a)	4.45	-	2.0	11.0	52	11.5
propylene oxide	0.13	4.98	7.5	2.3	36.0	82	7.8
isopropyl mercaptan	0.53(b)		-				
styrene	0.18(a)	2.05	-	0.9	6.8		9.0
tetrahydrofuran	0.19(a)		-	2.0	11.8		
tetrahydropyran	0.22		4.7			48	
thiophene	0.39(b)		-				
toluene	0.24	2.27	4.1	1.1	7.1	41	9.5
trichloroethane (in oxygen)	0.092		-	5.5*	57*		n/a
trichlorosilane	0.017		-	7.0	83		
triethylamine	0.22(a)	2.10	-	1.2	8.0		
vinyl acetate	0.16(a)	4.45	-	2.6	13.4		
vinyl acetylene	0.082		-	1.7	100		0
xylene(s)	0.2	1.96	-	1.0	7.0		

LMIE= lowest minimum ignition energy measured at optimum concentration (G in equation 6-1.3.1)
Stoi = stoichiometric concentration
Opt = optimum concentration at which LMIE was measured (C$_0$ in equation 6-1.3.1)
LFL = lower flammable limit
UFL = upper flammable limit
Su = fundamental burning velocity
LOC = limiting oxygen concentration of fuel-oxygen-nitrogen mixture
n/a = not applicable
(a) = LMIE calculated using heat of oxidation method [229]
(b) = LMIE is too high (measured at stoichiometric concentration) but is not amenable to calculation using the heat of oxidation method [229]

Note (1): It is possible that the fuel concentration most easily ignited by capacitive spark discharge, as reported in this table (C$_0$), might differ from that most easily ignited by other types of static discharge (eg brush discharge). See 2-6.2.1.
Note (2): LFL and UFL values in air taken primarily from NFPA 325.
Note (3): LMIE, LFL and UFL values in oxygen taken primarily from NFPA 53 (* denotes elevated temperature).
Note (4): Su values taken from [223].
Note (5): LOC values taken primarily from NFPA 69. Some reported values might be too high (see reference [229])

Page 259: add new reference: [229]: Britton, L.G., "Using Heats of Oxidation to Evaluate Flammability Hazards", Process Safety Progress, Vol. 21, No. 1 (2002)

Pages 266-267 under "Flash Point" and "Ignition Energy": Add series number "E" to ASTM 502 and 582 (viz. ASTM E 502, ASTM E 582)

Page 272 under "Surface Streamer": Fourth line: change "about" to "at least"