Web-based Alternative Greener Chemical, Product and Process Analysis Case Studies

[DTSC] Alternatives Analysis Symposium II
Sacramento, CA, July 28, 2010

CCS

Chemical Compliance Systems, Inc.
Lake Hopatcong, NJ

Green Standards – Current Status

California Green Chemistry Initiative (2007)

GOAL → *Change the way business is conducted in California*
"Cradle to Cradle"

Pending National Standard (ANSI) 2010

GOAL → *Define "'green" chemical characteristics and manufacturing factors*

Green Chemistry Legislation Pending 12-15 Other States

GOAL → *Model after California (?)*

Individual Company Initiatives (Beiersdorf AG, Proctor & Gamble, Wal-Mart)

GOAL → *Evaluate Their Supply Chain/Finished Products*

Centralized Chemical Toxic Information Databases– Worldwide Interest

California Green Chemistry Initiative

Toxic Information Clearinghouse Senate Bill 509 , 2008

Canadian Pollution Prevention Planning Database

Canadian Environmental Protection Act (CEPA), 1999

European Chemicals Agency

Registration, Evaluation, Authorization of Chemicals (REACH), 2006

Other States Pending

California Green Chemistry Initiative

Senate Bill 509

- Specify *"chemical hazard traits and environmental and toxicological endpoints"* – January 2011
- Implement **Toxic Information Clearinghouse** – January 2012

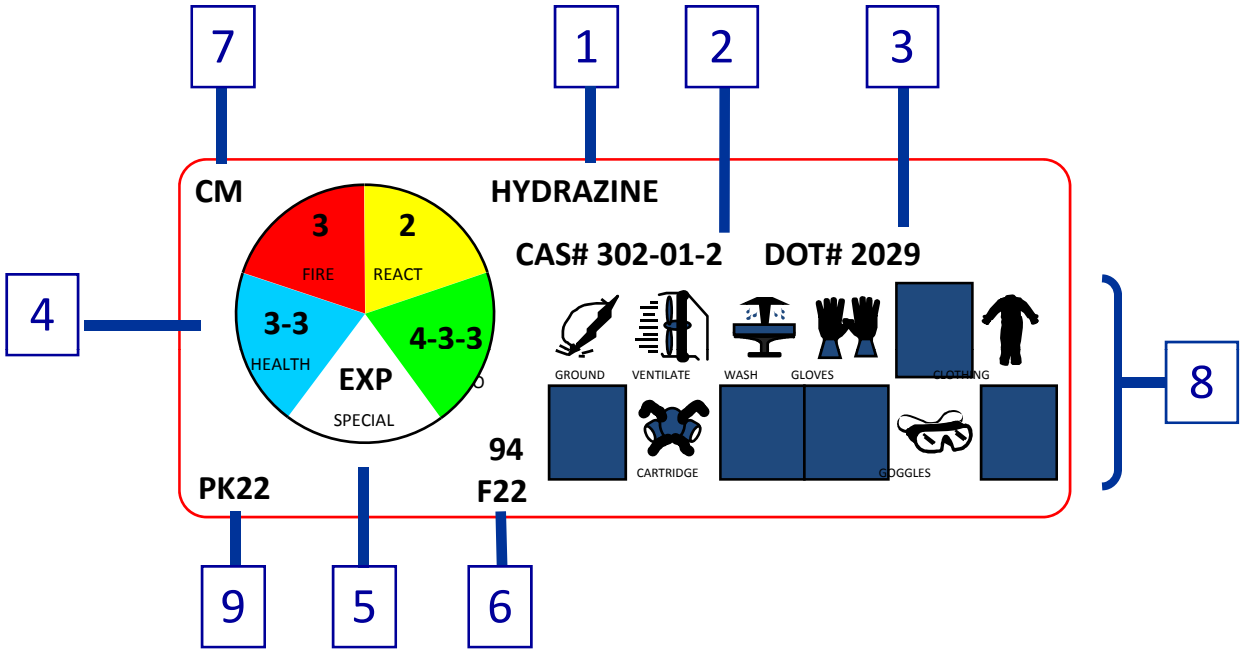
Assembly Bill 1879

- Identify & prioritize chemicals of concern (COCs)
- Establish process for evaluating COCs & their alternatives – January 2011

Public Access to Information

Public Utilization of Processes

Reading the CCS SAF-T-LABEL© - 1985



1. Chemical Name
2. CAS Registry Number
3. DOT ID Number
4. Hazard Ratings (0-Minimal, 4-Severe)
   - Fire-Health (Short Term-Long Term)
   - Reactivity-Environmental (Air-Water-Soil)
5. Special Hazard Indicator
   - OXY (Oxidizer) EXP (Explosive)
   - RAD (Radioactive) -W- (Water Reactive)
6. Year Received and Disposal Code
7. Special Health Hazard Indicator
   - C (Carcinogen) T (Teratogen)
   - M (Mutagen) N (Neurotoxin)
8. Recommended PPE
   - (symbols not overprinted)
9. SAF-T-Storage Code

CCS Databases Published in 1990 / Handbook in 1995

CCS Relational Chemical and Product Database (R-CPD) Statistics - 2010

25 Years of Data Compilation – *Ongoing Daily*

75,000,000	Data Elements
275,000	Chemicals
>1,000,000+	Product MSDSs
>10,000	Manufacturers
10,000+	Munitions (DoD / UK / Canada / NATO)
1,000	Public Data Sources
700	Chemical Regulatory Lists

CCS Relational Chemical and Product Database (R–CPD) Elements

Chemical

Cross Reference Dictionary
- Chemical Names
- Common Names
- Foreign Names
- Numeric Identifiers

Physical/Chemical
- Elemental Composition
- Redox Potential
- Pka/Pkb
- Log Koc
- Log Kow
- Other Constants

Health
- Acute
- Chronic

Safety
- Incompatibilities
- Spill Codes
- Disposal Codes
- Storage Codes

Ecological
- Toxicity
- Pesticides
- Long-term Effects
- Persistence
- Exposure

Green
- Ecological
- Health
- Safety

Alternatives
- Acids
- Antioxidants
- Bases
- Binders
- Chelators
- Oxidizers
- Propellants
- Reducers
- Solvents
- Surfactants
- UV Absorbers
- Viscosity Agents
- Other (~30)

Eco-Risk
- Species Factors
- Wildlife Toxicity
- Dietary Considerations
- Ingestion Rates
- Bioconcentration
- Bioaccumlation
- Biotransfer

Regulatory
- U.S. EPA
- U.S. DOL
- U.S. DOT
- U.S. FDA
- U.S. Other
- States
- Canada
- Europe
- Pacific Rim
- International
- Compounds
- CCS Compiled

Product
- Manufacturers
- Composition
- Description
- Generic Categories
- Inventories
- Alloys
- MSDS Links

Munition
- MIDAS
- OB/OD Emissions
- Live Fire Emissions

Munitions & Demilitarization “Green” Capability Status

- 2003 Specified 43 “Green” Chemical Characteristic Criteria
- 2003 Implemented Web-based “Green” Munitions Analytical Compliance System (G-MACS)
  - Existing Munitions *“Evaluate”* Capability
  - New Munitions *“Design”* Capability
  - *Applicable to Any Type Product (e.g., Furniture, Cosmetics, etc.)*
- Utilized By All JMC Demil Sites Since 2003 (13 → 8)
- Interest from 9 NATO Countries
- Interest from NASA
- Interest from Industry (e.g., Cosmetics, Furniture)

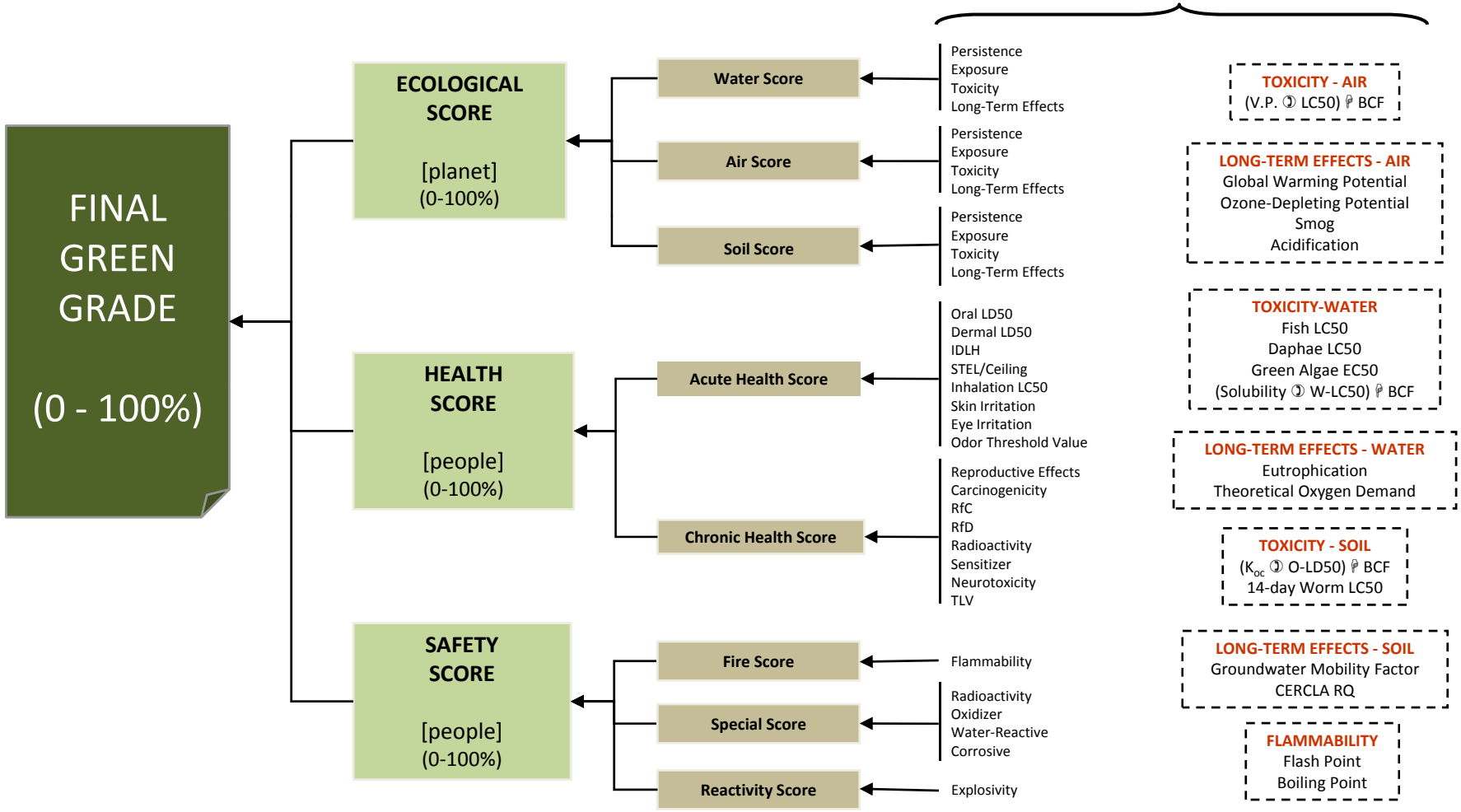
"GREEN" SCORING PROCESS

Munitions – Chemicals – Products – Processes – Wastestreams

10 Web-based Modules

Significance of each sub-score can be individually weighted

43 "Endpoint" Criteria



42/43 ENDPOINTS IN THE PENDING NATIONAL STANDARD

Combined COC Ratings & Composite Rankings

CAS #	CHEMICAL	Usage Quantity	Regulatory Impact	Eco	Health	Safety	COMPOSITE RANKING
25321-14-6	DINITROTOLUENE	40	0	75	42	67	224
118-96-7	TNT	0	83	74	62	33	252
55-63-0	NITROGLYCERIN	25	50	75	57	50	257
121-82-4	RDX	19	50	81	81	42	273
7439-92-1	LEAD	66	8	77	42	100	293
84-74-2	DIBUTYLPHTHALATE	44	17	82	71	92	305
7429-90-5	ALUMINUM	37	75	82	75	50	319
9004-70-0	NITROCELLULOSE	0	100	82	100	42	324
556-88-7	NITROGUANIDINE	31	100	74	95	33	333
7440-02-0	NICKEL	80	25	82	51	100	338
2691-41-0	HMX	54	100	81	92	25	352
7757-79-1	POTASSIUM NITRATE	49	75	73	99	67	363
15748-73-9	LEAD SALICYLATE	64	58	85	74	92	373
7790-98-9	AMMONIUM PERCHLORATE	58	100	81	98	58	395
102-76-1	TRIACETIN	53	100	80	97	92	422
57-11-4	STEARIC ACID	68	100	82	92	92	434
7778-80-5	POTASSIUM SULFATE	53	100	85	99	100	437
65997-15-1	CALCIUM SULFATE HEMIHYDRATE	71	100	100	85	83	439
119-75-5	2-NITRODIPHENYLAMINE	66	100	80	97	100	443
13114-72-2	METHYL DIPHENYLUREA	63	100	80	100	100	443
7440-21-3	SILICON	100	100	82	92	75	449
7440-44-0	CARBON	63	100	90	99	100	452
7439-89-6	IRON	100	100	83	99	100	482

G-MACS

"Green" Grade Report Card for MIDAS Library

Munition
DOCUMENT DESTROYER INCND M3
NSN: 1375002938132
DODIC: M605
Adjustable Weight
Standard

Final Green Grade

81.51 (100%)

Ecological Score: 68.03 (33.34% AW) (65 Pass/Fail)	Water Score: 64.89 (33.34% AW) (65 Pass/Fail)	Persistence: 50.68 (25%AW) (65 Pass/Fail) Exposure: 53.89 (25%AW) (65 Pass/Fail) Toxicity: 99.14 (25%AW) (65 Pass/Fail) Long-Term Effects: 55.87 (25%AW) (65 Pass/Fail)
	Air Score: 76.28 (33.33% AW) (65 Pass/Fail)	Persistence: 12.47 (25%AW) (65 Pass/Fail) Exposure: 92.66 (25%AW) (65 Pass/Fail) Toxicity: 99.99 (25%AW) (65 Pass/Fail) Long-Term Effects: 99.99 (25%AW) (65 Pass/Fail)
	Soil Score: 62.91 (33.33% AW) (65 Pass/Fail)	Persistence: 50.68 (25%AW) (65 Pass/Fail) Exposure: 50.71 (25%AW) (65 Pass/Fail) Toxicity: 100 (25%AW) (65 Pass/Fail) Long-Term Effects: 50.25 (25%AW) (65 Pass/Fail)
Health Score: 87.3 (33.33% AW) (65 Pass/Fail)	Acute Health Score: 79.73 (50.% AW) (65 Pass/Fail)	Oral LD50: 81.9 (12.5% AW) (65 Pass/Fail) Dermal LD50: 99.99 (12.5% AW) (65 Pass/Fail) IDLH: 99.73 (12.5% AW) (65 Pass/Fail) STEL/Ceiling: 95.73 (12.5% AW) (65 Pass/Fail) Inhalation LC50: 100 (12.5% AW) (65 Pass/Fail) Skin Irritation: 28.51 (12.5% AW) (65 Pass/Fail) Eye Irritation: 27.85 (12.5% AW) (65 Pass/Fail) Odor Threshold Value: 99.93 (12.5% AW) (65 Pass/Fail)
	Chronic Health Score: 94.87 (50% AW) (65 Pass/Fail)	Reproductive Effects: 99.95 (12.5% AW) (65 Pass/Fail) Carcinogenicity: 99.94 (12.5% AW) (65 Pass/Fail) RfC: 89.85 (12.5% AW) (65 Pass/Fail) RfD: 89.68 (12.5% AW) (65 Pass/Fail) Radioactivity: 100 (12.5% AW) (65 Pass/Fail) Sensitizer: 92.66 (12.5% AW) (65 Pass/Fail) Neurotoxicity: 92.29 (12.5% AW) (65 Pass/Fail) TLV: 94.59 (12.5% AW) (65 Pass/Fail)
Safety Score: 89.28 (33.33% AW) (65 Pass/Fail)	Fire Score: 95.15 (33.33% AW) (65 Pass/Fail)	Flammability: 95.15 (100% AW) (65 Pass/Fail)
	Special Score: 76.38 (33.34% AW) (65 Pass/Fail)	Radioactivity: 100 (25% AW) (65 Pass/Fail) Oxidizer: 12.88 (25% AW) (65 Pass/Fail) Water-Reactive: 92.66 (25% AW) (65 Pass/Fail) Corrosive: 100 (25% AW) (65 Pass/Fail)
	Reactivity Score: 96.32 (33.33% AW) (65 Pass/Fail)	Explosivity/Unstability/Shock Sensitivity/Heat/Pressure Sensitivity: 96.32 (100% AW) (65 Pass/Fail)

Munition: DOCUMENT DESTROYER INCND M3

Ecological Score: 68.03 (65/Pass/Fail)

Water Score: 64.89 (33.34%) (65 Pass/Fail)							
Persistence: (25%)		Exposure: (25%)		Toxicity: (25%)		Long-Term Effect: (25%)	
Score	Pass/Fail	Score	Pass/Fail	Score	Pass/Fail	Score	Pass/Fail
50.68	65	53.89	65	99.14	65	55.87	65

Air Score: 76.28 (33.33%) (65 Pass/Fail)							
Persistence: (25%)		Exposure: (25%)		Toxicity: (25%)		Long-Term Effect: (25%)	
Score	Pass/Fail	Score	Pass/Fail	Score	Pass/Fail	Score	Pass/Fail
12.47	65	92.66	65	99.99	65	99.99	65

Soil Score: 62.91 (33.33%) (65 Pass/Fail)							
Persistence: (25%)		Exposure: (25%)		Toxicity: (25%)		Long-Term Effect: (25%)	
Score	Pass/Fail	Score	Pass/Fail	Score	Pass/Fail	Score	Pass/Fail
50.68	65	50.71	65	100	65	50.25	65

Detail Chemical List *(partial)* Sort by: Ecological Score

CAS# 50-00-0

Chemical: Formaldehyde

Percentage: <0.01%

Weight: 0.000846607545 (Lbs)

Master: Enamel Gry (45)

Ecological Score: 55.1 (65 Pass/Fail)				
Water Score: 46.34 (33.34%) (65 Pass/Fail)	Persistence: (25%)	Exposure: (25%)	Toxicity: (25%)	Long-Term Effect: (25%)
	50	48.61	0	86.75
Air Score: 61.68 (33.33%) (65 Pass/Fail)	Persistence: (25%)	Exposure: (25%)	Toxicity: (25%)	Long-Term Effect: (25%)
	59.51	95.25	0	91.97
Soil Score: 57.28 (33.33%) (65 Pass/Fail)	Persistence: (25%)	Exposure: (25%)	Toxicity: (25%)	Long-Term Effect: (25%)
	50	54.1	100	25

Chemical Constituents in Munition: DOCUMENT DESTROYER INCND M3

Sort by: Ecological - Soil Score

Pass/Fail Standard: 65

CAS#	Chemical	Score	%	Weight in Lbs.	Master Name	Master SEQ#
50-00-0	Formaldehyde	57.28	< 0.01	0.000846607545	Enamel Gry	45
7738-94-5	Chromic Acid	58.35	< 0.01	0.0000010078773	Chromate Coating	133
592-87-0	Pb Thiocyanate	58.87	< 0.01	0.0000217890072	Primer Mix	285
10022-31-8	Ba Nitrate	59.12	< 0.01	0.0000049600992	Primer Mix	285
7439-92-1	Lead	61.03	< 0.01	0.0097213341456	Pb Alloy, Zn Alloy, Brass, Brass, Brass	90,124,255,268,274
7631-99-4	Na Nitrate	61.32	87.12	96.5024	Ign chg, Oxidizing Agent #3 Chg 1	405,413
7778-74-7	K Perchlorate	61.35	< 0.01	0.000009757125	Ign Comp	236
108-10-1	Methyl Isobutyl Keto	63.70	0.01	0.01630263971172	Adhesive, Adhesive, Shellac,Shellac	13,68, 262, 279
108-65-6	Propyleneglycol Mono	64.05	< 0.01	0.00169321509	Enamel Gry	45
7440-47-3	Chromium	64.08	0.04	0.0441677864628	Stainless Wire, Steel, Al Alloy, Steel	3,182, 203,311
7440-43-9	Cadmium	64.10	< 0.01	0.00008159639508	Zn Alloy, CD Coating	124,177
78-83-1	Isobutyl Alcohol	64.15	0.01	0.014392328265	Enamel Gry, Enamel Red	45,54
67-63-0	Isopropyl Alcohol	64.62	< 0.01	0.00169321509	Enamel Gry	45
78-93-3	Methyl Ethyl Ketone	65.75	< 0.01	0.00134080758	Adhesive	13

Detailed Chemical Data *(partial list)*
Chemical: SODIUM NITRATE CAS No: 7631-99-4

Family	Inorganic salt		
Description	Colorless Crystals or Powder		
Formula	Formula: Na-N-03 Extend Formula: Formula Weight: 85.01		
Physical	Physical State: S Physical Description: Odorless, colorless-to-white crystals or powder		
Purity	100	PH:	0
RTECS	WC5600000	ALPHA	WR6200000
Incompatibility	Metals, Barium, Compounds, Metallic Powders		
Flash Point	Flash Point: 0 Flash Point Method: Flash Point Modifier:		
Gravity	2.26	Density	2.26
Melting Point	Lower: 5.85 Upper: 0 UOM: F		
Water Solubility	92.1% @25°C (77°F)		
Boiling Point	380°C (716°F)	Vapor Pressure	0
IDLH PPM	0	IDLH MGM3	0
Volatile	0	Odor Index	0
Chemical Weapon	False	CW Precursor	False
Fluka Storage	Light Sensitive: False Moist Sensitive: False Hygroscopic: False		
Log	Pac Lower: 0 Pac Upper: 0 RTI-P: 0 BCF: 316		
Lake Days	Biod: 0 Photo: 0 Hydro: 0		
Property	Toxic: True High_toxic: False Teratogen: False Mutagen: False Carcinogen: False		
	Neurotoxin: False Flammable: False Reactive: False Water Reactive: False Explosive: False		
	Irritant: True Corrosive: False Stench: False Radioactive: False Radiotoxic: False		

GP-CAS

"Green" Grade Report Card for Product Index

Product
"Foam Care" Skin Care Product; Hand Scrub; Antimicrobial Skin Cleanser
Adjustable Weight
Standard
Manufacturer
Kimberly-Clark Corporation

Final Green Grade

98.97 (100%)

	Ecological Score: 98.88 (33.34% AW) (65 Pass/Fail)	Water Score: 98.63 (33.34% AW) (65 Pass/Fail)	Persistence: 98 (25% AW) (65 Pass/Fail) Exposure: 97.88 (25% AW) (65 Pass/Fail) Toxicity: 99.83 (25% AW) (65 Pass/Fail) Long-Term Effects: 98.81 (25% AW) (65 Pass/Fail)
		Air Score: 99.44 (33.33% AW) (65 Pass/Fail)	Persistence: 98.29 (25% AW) (65 Pass/Fail) Exposure: 99.6 (25% AW) (65 Pass/Fail) Toxicity: 99.99 (25% AW) (65 Pass/Fail) Long-Term Effects: 99.86 (25% AW) (65 Pass/Fail)
		Soil Score: 98.58 (33.33% AW) (65 Pass/Fail)	Persistence: 98 (25% AW) (65 Pass/Fail) Exposure: 98.34 (25% AW) (65 Pass/Fail) Toxicity: 100 (25% AW) (65 Pass/Fail) Long-Term Effects: 98 (25% AW) (65 Pass/Fail)
	Health Score: 99.01 (33.33% AW) (65 Pass/Fail)	Acute Health Score: 98.76 (50.% AW) (65 Pass/Fail)	Oral LD50: 98.86 (12.5% AW) (65 Pass/Fail) Dermal LD50: 100 (12.5% AW) (65 Pass/Fail) IDLH: 98.25 (12.5% AW) (65 Pass/Fail) STEL/Ceiling: 100 (12.5% AW) (65 Pass/Fail) Inhalation LC50: 100 (12.5% AW) (65 Pass/Fail) Skin Irritation: 96 (12.5% AW) (65 Pass/Fail) Eye Irritation: 97 (12.5% AW) (65 Pass/Fail) Odor Threshold Value: 100 (12.5% AW) (65 Pass/Fail)
		Chronic Health Score: 99.26 (50% AW) (65 Pass/Fail)	Reproductive Effects: 100 (12.5% AW) (65 Pass/Fail) Carcinogenicity: 100 (12.5% AW) (65 Pass/Fail) RfC: 99.2 (12.5% AW) (65 Pass/Fail) RfD: 99.2 (12.5% AW) (65 Pass/Fail) Radioactivity: 100 (12.5% AW) (65 Pass/Fail) Sensitizer: 99.86 (12.5% AW) (65 Pass/Fail) Neurotoxicity: 96 (12.5% AW) (65 Pass/Fail) TLV: 99.69 (12.5% AW) (65 Pass/Fail)
	Safety Score: 99 (33.33% AW) (65 Pass/Fail)	Fire Score: 97 (33.33% AW) (65 Pass/Fail)	Flammability: 97 (100% AW) (65 Pass/Fail)
		Special Score: 100 (33.34% AW) (65 Pass/Fail)	Radioactivity: 100 (25% AW) (65 Pass/Fail) Oxidizer: 100 (25% AW) (65 Pass/Fail) Water-Reactive: 100 (25% AW) (65 Pass/Fail) Corrosive: 100 (25% AW) (65 Pass/Fail)
		Reactivity Score: 100 (33.33% AW) (65 Pass/Fail)	Explosivity/Unstability/Shock Sensitivity/Heat/Pressure Sensitivity: 100 (100% AW) (65 Pass/Fail)

GP-CAS

"Green" Grade Report Card for Product Index

Product
Yellow Spray Stencil Ink
Adjustable Weight
Standard
Manufacturer
Ideal Stencil Machine & Tape Co.

Final Green Grade

70.78 (100%)

	Ecological Score: 68.75 (33.34% AW) (65 Pass/Fail)	Water Score: 65.15 (33.34% AW) (65 Pass/Fail)	Persistence: 50 (25% AW) (65 Pass/Fail) Exposure: 52.16 (25% AW) (65 Pass/Fail) Toxicity: 93.78 (25% AW) (65 Pass/Fail) Long-Term Effects: 64.66 (25% AW) (65 Pass/Fail)
		Air Score: 69.91 (33.33% AW) (65 Pass/Fail)	Persistence: 25.87 (25% AW) (65 Pass/Fail) Exposure: 62.6 (25% AW) (65 Pass/Fail) Toxicity: 97.96 (25% AW) (65 Pass/Fail) Long-Term Effects: 93.2 (25% AW) (65 Pass/Fail)
		Soil Score: 71.19 (33.33% AW) (65 Pass/Fail)	Persistence: 50 (25% AW) (65 Pass/Fail) Exposure: 69.09 (25% AW) (65 Pass/Fail) Toxicity: 99.88 (25% AW) (65 Pass/Fail) Long-Term Effects: 65.78 (25% AW) (65 Pass/Fail)
	Health Score: 69.91 (33.33% AW) (65 Pass/Fail)	Acute Health Score: 72.44 (50.% AW) (65 Pass/Fail)	Oral LD50: 84.26 (12.5% AW) (65 Pass/Fail) Dermal LD50: 99.18 (12.5% AW) (65 Pass/Fail) IDLH: 61.75 (12.5% AW) (65 Pass/Fail) STEL/Ceiling: 99.73 (12.5% AW) (65 Pass/Fail) Inhalation LC50: 100 (12.5% AW) (65 Pass/Fail) Skin Irritation: 37 (12.5% AW) (65 Pass/Fail) Eye Irritation: 37 (12.5% AW) (65 Pass/Fail) Odor Threshold Value: 60.06 (12.5% AW) (65 Pass/Fail)
		Chronic Health Score: 67.39 (50% AW) (65 Pass/Fail)	Reproductive Effects: 60 (12.5% AW) (65 Pass/Fail) Carcinogenicity: 100 (12.5% AW) (65 Pass/Fail) RfC: 50.59 (12.5% AW) (65 Pass/Fail) RfD: 20.13 (12.5% AW) (65 Pass/Fail) Radioactivity: 100 (12.5% AW) (65 Pass/Fail) Sensitizer: 100 (12.5% AW) (65 Pass/Fail) Neurotoxicity: 16 (12.5% AW) (65 Pass/Fail) TLV: 92.38 (12.5% AW) (65 Pass/Fail)
	Safety Score: 73.67 (33.33% AW) (65 Pass/Fail)	Fire Score: 21 (33.33% AW) (65 Pass/Fail)	Flammability: 21 (100% AW) (65 Pass/Fail)
		Special Score: 100 (33.34% AW) (65 Pass/Fail)	Radioactivity: 100 (25% AW) (65 Pass/Fail) Oxidizer: 100 (25% AW) (65 Pass/Fail) Water-Reactive: 100 (25% AW) (65 Pass/Fail) Corrosive: 100 (25% AW) (65 Pass/Fail)
		Reactivity Score: 100 (33.33% AW) (65 Pass/Fail)	Explosivity/Unstability/Shock Sensitivity/Heat/Pressure Sensitivity: 100 (100% AW) (65 Pass/Fail)

Objective & Quantitative Equivalent Product Comparisons

Automotive Degreasers

PRODUCT MANUFACTURER	Green Grade	Eco Score	Water Score (4)	Air Score (4)	Soil Score (4)	Health Score	Acute Score (8)	Chronic Score (8)	Safety Score	Fire Score (1)	Special Score (4)	Reactivity Score (1)
Degreaser #1	84	94	93	96	95	85	92	78	72	42	79	95
Degreaser #2	96	96	95	98	94	96	97	95	96	87	100	100

“Green” Product Assessment Parameters

- NSNs = Functionally equivalent products
- 5 NSNs Selected from USN Facility Inventory

– 7917	Sealants [A]	3 Products
– 6050	Varnish, Fungus Resistant	3 Products
– 2487	Spray Lacquer	9 Products
– 4597	Sealants [B]	10 Products
– 6890	Spray Adhesive	10 Products
		35 Products

- GP–CAS “Green” Scoring Criteria

Summarized "Green" Comparison for Five N.I. NSNs

						LOLs		Constituents	
NSN	Product Type	No. of Products	Green Grades	Noteworthy Low Scores		Unique	Total	No.	Total %
– 2487	Lacquer	9	75–79 (4)[a]	Fire Chronic Health Eco – Water	15–46 (9) 61–66 (4) 62 (1)	8–9	16–63	3–11	84–110
– 6950	FR Varnish	3	79–90 (11)	Fire	18–55 (3)	7–9	12–2 7	3–11	52–173
– 4597	Sealant	10	87–100 (13)	Eco – Soil	79 (1)	1–11	1–26	1–6	2–120
– 7917	Sealant	3	85–99 (14)	Safety Fire React	63 (1)[b] 55 (1) 39 (1)	5–7	5–10	1–4	3–110
– 6860	Spray Adhesive	10	75–99 (24)	Fire	10–37 (6)	8	8–21	2–5	4–100

[a] Range spread (in %)

[b] Number of products within this NSN

NSN: 8040009386860 (SPRAY ADHESIVE)

PRODUCT		MSDS		GREEN GRADE (0–100%)
MANUFACTURER	NAME	# CHEMs	TOTAL %	
3M Company	Spray Adhesive 77	4	4.0	**99**
Camie-Campbell Inc.	General Purpose Adhesive Spray	5	43.0	**90**
National Aerosol Products	MMM-1058A Adhesive	2	77.0	**84**
Contact Industries	Multipurpose Spray-On Adhesive	2	55.0	**84**
Plasti-Kote	Multipurpose Spray-On Adhesive MMM-A-1058A	4	58.0	**83**
LHB Industries	MMM-A-1058A Rubber Adhesive	4	77.5	**81**
LHB Industries	So-Sure Rubber Adhesive #532D800	5	83.8	**80**
LHB Industries	MMM-A-1058 Rubber Adhesive	4	90.0	**78**
Camie-Campbell Inc.	L-6261 GSA Adhesive	5	90.0	**78**
3M Company	3M Super 77 Spray Adhesive	5	100.0	**75**

Functionally Equivalent Product Conclusions

- Only 1/5 Functionally Equivalent NSNs Was Equally "Green" – *Spray Lacquer*
- Differences in Product "Green Grades" Within an NSN Ranged from 4–24%
- Inverse Proportionality Between "Green" Grades & MSDS Total % Constituents
- GP–CAS Quantitatively Grades Individual Product Greenness
- GP–CAS Effectively Compares Product Greenness for Functionally Equivalent NSNs
- GP–CAS readily:
  - ✓ Differentiates"Green" Disparities Within NSNs
  - ✓ Identifies Unique & Total Regulatory Impacts
  - ✓ Tallies the # and % MSDS Constituents

GP–CAS Cleaning Product Assessments for Concentrates & Ready-to-Use Products

	Green Grades	
	Concentrate	**RTU**
1. High density caustic-based solid auto dishwash product	87.2	99.9
2. Alkaline (non-caustic) solid auto dishwash product	92.3	99.9
3. High density one shot liquid caustic based laundry detergent	90.6	99.9
4. Laundry detergent boosted with sustainable surfactant options	91.0	99.9
5. Alkaline one shot non-caustic liquid laundry detergent, with phosphates	88.8	99.9
6. “Greener” alternative to Formula 5 without phosphates	88.9	99.9
7. Green Seal-certified all purpose cleaner (concentrate for dilution)	96.7	99.9
8. Green Seal-certified all purpose cleaner (concentrate for dilution)	97.7	99.7
9. Green Seal-certified all purpose cleaner (concentrate for dilution)	98.6	99.8
10. Chlorinated alkaline high density cleaner with phosphates (concentrate for dilution)	96.8	99.8
11. Ready-to-use chlorinated alkaline bathroom cleaner	--	99.1
12. Same as Formula 11 (no chlorine)	--	99.4

GP–CAS Solvent Assessments for Concentrates and Dilutions

Solvent	GREEN GRADES		
	Concentrate	10%	1%
2-butoxyethanol	74.3	97.3	99.6
Propylene Glycol Methyl Ether	77.7	97.7	99.7
2-butoxypropanol	92.2	99.1	99.8

Conclusions

- Formulation “greenness” is affected by its concentration
- “Green” grades for concentrates were commendable to impressive, but 6/10 could be slightly improved
- “Green” grades for RTU were all maximal
- GP–CAS is sufficiently sensitive to at least differentiate 2% concentration differences
- GP–CAS is an objective and quantitative tool effective in evaluation of product formulations
- Alternative constituents in GP–CAS makes this tool equally valuable for product design

G–PACS Process Comparison

GPA Process Evaluation Multiple Mix Process DIANEPENG

Print Screen Refresh Close

Process "Greeness" Analysis

Adjustable Weight List: Preferred

Process Name	T.	ALT	Chem.%	Overall Assessment	Green Grade (100%)	Ecological (33.34%) (65 Pass/Fail)	Health (33.33%) (65 Pass/Fail)	Safety (33.33%) (65 Pass/Fail)	Regulatory (LOLs)
+ CCS_PROCESS 1 (Chemical of Concern) Manufactured by Chemical Compliance Systems, Inc.	G		100%	MOST GREEN	84.4	83.89	83.08	86.24	
+ CCS_PROCESS 2 Manufactured by Chemical Compliance Systems, Inc.	G		100%	LEAST GREEN	81.3	81.62	79.47	82.82	

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G–PACS Step Evaluation

Process "Greeness" Analysis

Adjustable Weight List: Preferred

Process Name	T.	ALT	Chem.%	Overall Assessment	Green Grade (100%)	Ecological (33.34%) (65 Pass/Fail)	Health (33.33%) (65 Pass/Fail)	Safety (33.33%) (65 Pass/Fail)	Regulatory (LOLs)
− CCS_PROCESS 1 (Chemical of Concern) Manufactured by Chemical Compliance Systems, Inc.	G		100%	**MOST GREEN**	84.4	83.89	83.08	86.24	
+ Step 1 (Compatibility)	P		2.35%		79.72	78.13	83.09	77.94	
+ Step 2 (Compatibility)	P		27.66%		87.52	86.09	86.35	90.1	
+ Step 3 (Compatibility)	P		4.28%		71.14	73.94	74.54	64.95	
+ Step 4 (Compatibility)	P		32.45%		77.22	77.2	72.92	81.54	
+ Step 5 (Compatibility)	P		10.43%		77.63	75.95	78.26	78.68	
+ Step 6 (Compatibility)	P		4.6%		96.86	96.52	98.96	95.09	
+ Step 7 (Compatibility)	P		10.29%		97.62	97.46	97.86	97.53	
+ Step 8 (Compatibility)	P		7.93%		96.04	96.13	95.87	96.13	
+ CCS_PROCESS 2 Manufactured by Chemical Compliance Systems, Inc.	G		100%	**LEAST GREEN**	81.3	81.62	79.47	82.82	

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G–PACS Alternative Chemicals [1]

Process "Greeness" Analysis

Adjustable Weight List: Preferred

Process Name	T.	ALT	Chem.%	Overall Assessment	Green Grade (100%)	Ecological (33.34%) (65 Pass/Fail)	Health (33.33%) (65 Pass/Fail)	Safety (33.33%) (65 Pass/Fail)	Regulatory (LOLs)
− CCS_PROCESS 1 Manufactured by Chemical Compliance Systems, Inc.	G		100%	**MOST GREEN**	84.4	83.89	83.08	86.24	
+ Step 1 (Compatibility)	P		0%		N/A	N/A	N/A	N/A	
+ Step 2 (Compatibility)	P		0%		N/A	N/A	N/A	N/A	
− Step 3 (Compatibility)	P		100%		71.14	73.94	74.54	[illegible]	
WATER CAS#:7732-18-5 (Values) (Synonyms) (PHY. Property) (Alternative)	X		0%		N/A	N/A	N/A	N/A	
TOLUENE CAS#:108-88-3 (Values) (Synonyms) (PHY. Property) (Alternative)	X		59.79%		69.13	72.21	[illegible]	75	
POTASSIUM TERT-BUTOXIDE CAS#:865-47-4 (Values) (Synonyms) (PHY. Property) (Alternative)	X		40.21%		74.14	76.52	95.9	[illegible]	
+ Step 4 (Compatibility)	P		0%		N/A	N/A	N/A	N/A	
+ Step 5 (Compatibility)	P		0%		N/A	N/A	N/A	N/A	
+ Step 6 (Compatibility)	P		0%		N/A	N/A	N/A	N/A	
+ Step 7 (Compatibility)	P		0%		N/A	N/A	N/A	N/A	
+ Step 8 (Compatibility)	P		0%		N/A	N/A	N/A	N/A	
+ CCS_PROCESS 2 Manufactured by Chemical Compliance Systems, Inc.	G		100%	**LEAST GREEN**	81.3	81.62	79.47	82.82	

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42 Alternative Chemical Constituent Generic Categories

Chemical	Generic Category
8	Abrasives
34	Absorbents
1555	Acids
304	Additives
3982	Alloys
1	Anticorrosives
13	Antidandruff Agents
15	Antifoaming Agents
104	Antimicrobials
48	Antioxidants
25	Antiperspirants
826	Antistatic Agents
90	Bases
68	Binders

Chemical	Generic Category
199	Biological Additives
3	Bleaching Agents
496	Botanicals
76	Buffering Agents
44	Chelating Agents
207	Colorants
26	Denaturants
36	Deodorants
20	Dipilating Agents
985	Emollients
112	Emulsion Stabilizers
269	Film-Formers
245	Hair Dyes
153	Humectants

Chemical	Generic Category
407	Ionic Liquids
90	Opacifiers
43	Oral Care Agents
913	Oxidizing Agents
123	Preservatives
13	Propellants
28	Reducing Agents
649	Solvents
13	Solvents-Chloro
74	Solvents-FDA
141	Solvents-NCI
394	Surfactants
61	UV Absorbers
113	Viscosity Controlling Agents

G–PACS Alternative Chemicals [2]

Alternative for CAS#: 108-88-3 TOLUENE

Chemical Class

- **SOLVENTS**
  - ☐ **Alcohols**
  - ☐ **VOC's**
  - ☐ **SVOC's**
    - ☐ **PAH**
    - ☐ **Phenyls**
  - ☐ **F.D.A. Solvents**
  - ☑ **E.P.A. Solvents**
  - ☐ **Chlorinated**
- **ACIDs**
- **BASES**
- **OXIDIZERS**
- **REDUCING AGENTS**
- **ANTIOXIDANTS**
- **BINDERS**
- **SURFACTANTS**

Check Chemical

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G–PACS Alternative Chemicals [3]

Alternative for CAS#: 108-88-3 TOLUENE

GREEN GRADE: 69.13

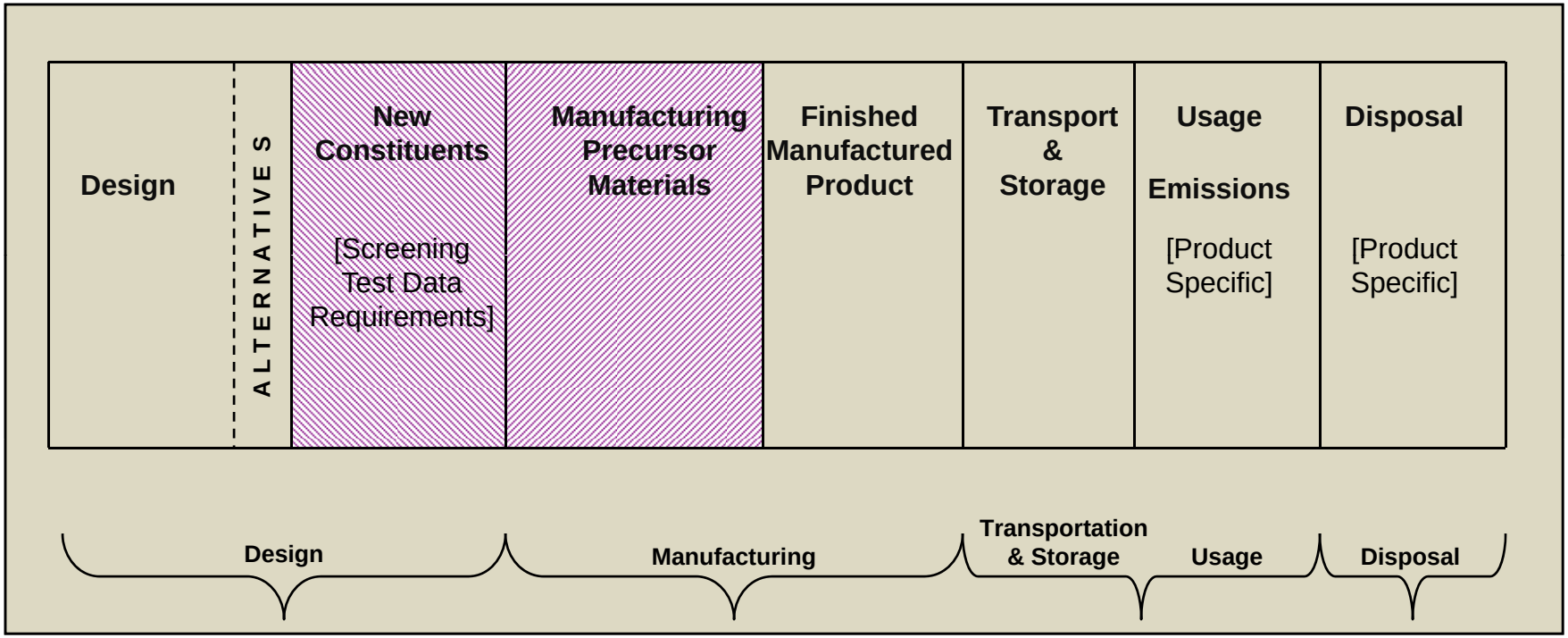
Ecological Score: 72.21 Health Score: 60.17 Safety Score: 75

Adjustable Weight : Preferred

EPA SOLVENTS LIST

CAS No.	Chemical	GREEN GRADE 100%	Ecological 33.34%	Health 33.33%	Safety 33.33 %	More Info	Regulatory (LOLs)
5989-54-8	(-)-1-METHYL-4-(1-METHYLET	92.63	78.63	99.28	100	(Details)	(LOLs)
124-11-8	1-Nonene	92.6	78.15	99.65	100	(Details)	(LOLs)
95-65-8	3,4-DIMETHYLPHENOL	91.5	78.32	96.19	100	(Details)	(LOLs)
108-68-9	3,5-DIMETHYLPHENOL	91.49	78.33	96.14	100	(Details)	(LOLs)
564-02-3	2,2,3-Trimethylpentane	91.19	73.92	99.65	100	(Details)	(LOLs)
554-14-3	2-METHYLTHIOPHENE	91.18	76.64	96.92	100	(Details)	(LOLs)
75-73-0	Tetrafluoromethane	91.11	75.44	97.89	100	(Details)	(LOLs)
127-91-3	á-PINENE	90.73	76.73	95.48	100	(Details)	(LOLs)
76-14-2	1,2-Dichlorotetrafluoroethane	90.34	72.47	98.56	100	(Details)	(LOLs)
119-65-3	Isoquinoline	89.68	76.26	92.78	100	(Details)	(LOLs)
78-75-1	1,2-DIBROMOPROPANE	89.67	72.3	96.7	100	(Details)	(LOLs)
108-48-5	2,6-LUTIDINE	89.38	73.3	94.86	100	(Details)	(LOLs)
107-04-0	1-BROMO-2-CHLOROETHANE	88.63	70.97	94.92	100	(Details)	(LOLs)
95-87-4	2,5-DIMETHYLPHENOL	88.6	78.32	95.8	91.66	(Details)	(LOLs)
74-97-5	CHLOROBROMOMETHANE	88.28	71.69	93.14	100	(Details)	(LOLs)
76-01-7	PENTACHLOROETHANE	88.15	67.93	96.53	100	(Details)	(LOLs)
124-18-5	n-Decane	87.12	81.19	96.84	83.34	(Details)	(LOLs)
100-51-6	BENZYL ALCOHOL	86.61	75.42	92.74	91.67	(Details)	(LOLs)
74-95-3	Methane, dibromo-	86.23	73.59	93.45	91.67	(Details)	(LOLs)
629-50-5	n-Tridecane	85.68	81.84	99.28	75.93	(Details)	(LOLs)

“Green” Lifecycle Considerations
(Within Each/Across All)



GP–CAS Product (Design) Module

G–PACS Process Module

GP–CAS Product (Evaluate) Module

G–WACS Waste Module

Chemicals of Concern Module

Integrated "Green" Chemical and Engineering Sustainability System

GREEN SUSTAINABILITY GRADE (0–100%)

Chemical or Product Green Grade
(0 – 100%)

=

Ecological Green Score	= Air + Water + Soil Green Scores	= 21 Endpoint Criteria
Health Green Score	= Acute + Chronic Health Green Scores	= 16 Endpoint Criteria
Safety Green Score	= Fire + Reactivity + 4 Special Green Scores	= 6 Endpoint Criteria

+

Process Chemical Green Grade
(0 – 100%)

=

Ecological Green Score	= Air + Water + Soil Green Scores	= 21 Endpoint Criteria
Health Green Score	= Acute + Chronic Health Green Scores	= 16 Endpoint Criteria
Safety Green Score	= Fire + Reactivity + 4 Special Green Scores	= 6 Endpoint Criteria

+

Process Engineering Green Grade
(0 – 100%)

=

Renewable Source Materials Green Score	= 6 Endpoint Criteria
Process Mass Efficiency & Waste Green Score	= 8 Endpoint Criteria
Energy Consumption Green Score	= 5 Endpoint Criteria
Water Usage Green Score	= 5 Endpoint Criteria
Process Safety Green Score	= 10 Endpoint Criteria

+

Wastestream Green Grade
(0 – 100%)

=

Ecological Green Score	= Air + Water + Soil Green Scores	= 21 Endpoint Criteria
Health Green Score	= Acute + Chronic Health Green Scores	= 16 Endpoint Criteria
Safety Green Score	= Fire + Reactivity + 4 Special Green Scores	= 6 Endpoint Criteria

Summary

	STATUS
SB 509 Requirements	
➢ Chemical Hazard Traits and Environmental/Toxicological Endpoints	• Utilized & Available Since 2003
➢ Toxic Information Clearinghouse	• Progressively Developed Since 2985 • Currently 75 Million Data Elements • 275,000 Chemicals • Alternative Chemicals
AB 1879 Requirements	
➢ Identify & Prioritize Chemicals of Concern (COCs)	• Utilized Since 2004
➢ Process for Evaluating COCs and Their Alternatives	• Utilized Since 2004
Public Access to Information	• Data Selection Screen Advisable
Public Utilization of Processes	• Simpler Report Versions Customizable

For a remote demonstration, or more information, please contact:

Dr. George Thompson

CCS

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