Assessment of Alternatives to Cleaners and Sanitizers for the Brewing Industry

Supplement 1:P20ASys Raw Data Used in EHS Evaluations



Contents

Baseline Cleaners	р.	. 2
Alternative Cleaners	ɔ. í	10
Baseline & Alternative Sanitizers	o. 1	19

Baseline Cleaners

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
ACUTE HUMAN EFFECTS				
Inhalation Toxicity	LC50 ppm			
Inhalation Toxicity	Vapor GHS Category Level			
Inhalation Toxicity	mg/l gas/vapor			
Inhalation Toxicity	mg/l dust/mist/fume			
Inhalation Toxicity	Key Phrases	May cause breathing difficulties if inhaled	Harmful if inhaled	Not considered harmful
Inhalation Toxicity	Solid GHS Category Level	3		
Inhalation Toxicity	GHS H Phrases	H332, H305		
Oral Toxicity	LD50 mg/kg	2800	2000	
Oral Toxicity	Key Phrases	Harmful if swallowed	Harmful if swallowed	May be harmful if swallowed
Oral Toxicity	GHS H Phrases	H302		
Oral Toxicity	GHS Category Level	4		
Dermal Toxicity	LD50 mg/kg	1999	1350	
Dermal Toxicity	Key Phrases		Harmful in contact with skin	May be harmful
Dermal Toxicity	GHS H Phrases			
Dermal Toxicity	GHS Category Level			
Respiratory Irritation	Key Phrases	Evidence in humans and animals shows slight or minor reversible respiratory irritation effects	Evidence in humans or animals shows mild reversible respiratory irritation effects; Low to moderate frequency of occurrence	
Respiratory Irritation	GHS H Phrases	H335	H335	

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
Respiratory Irritation	GHS Category Level			
Dermal Irritation	Key Phrases	Reversible skin irritation	Existing human and animal data, in	Existing human and animal data,
		effects; Irritant	vitro data or information from	in vitro data or information from
			structurally related compounds	structurally related compounds
			shows irreversible skin burns;	shows irreversible skin burns;
			Corrosive	Corrosive
Dermal Irritation	GHS Category Level	1C, 2	1A, 1	1A, 1
Dermal Irritation	GHS H Phrases	H315	H314	H314
Eye Irritation	Key Phrases	Reversible irritation effects	Existing human and animal data, in	Existing human and animal data,
		on the eyes from single or	vitro data or information from	in vitro data or information from
		repeated exposure;	structurally related compounds	structurally related compounds
		Irritating	shows irreversible eye damage;	shows irreversible eye damage;
			Irreversible	Irreversible
Eye Irritation	GHS H Phrases	H319	H318, H314	H318, H314
Eye Irritation	GHS Category Level	2A	1	1
Exposure Limits	PEL/TLV ppm			
Exposure Limits	PEL/TLV (dusts/particles) mg/m3	2	2	2
Exposure Limits	GHS Category Level	1		
IDLH	ppm		10	
Health	NFPA/HMIS 0,1,2,3,4	1	3	2
CHRONIC HUMAN EFFECT	rs			
Carcinogen	IARC Category			
Carcinogen	EPA CLASS Category			
Carcinogen	ACGIH Category			
Carcinogen	OSHA Category		No components are listed as	No components are listed as
			carcinogens by OSHA	carcinogens by OSHA
Carcinogen	Key Phrases		No component present at greater	No component present at
			than or equal to 0.1% as probable,	greater than or equal to 0.1% as
			possible or confirmed human	probable, possible or confirmed
			carcinogen	human carcinogen
Carcinogen	GHS H Phrases			
Carcinogen	GHS Category			
Carcinogen	Prop 65 Category	No; not listed on prop 65		No; not listed on prop 65
Mutagen/ Teratogen	Key Phrases	Not expected to be	Not expected to be mutagenic in	Not expected to be mutagenic in
		mutagenic in humans	humans	humans
Mutagen/ Teratogen	GHS H Phrase			
Mutagen/ Teratogen	GHS Category			

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
Reproductive/	Key Phrases		Not expected to have reproductive	Not expected to have
Developmental			effects	reproductive effects
Reproductive/	GHS H Phrases			
Developmental				
Reproductive/	GHS Category			
Developmental				
Reproductive/	Prop 65 Category	No; not listed on prop 65		No; not listed on prop 65
Developmental				
Neurotoxicity	GHS Category - STOT - Single			
	Exposure			
Neurotoxicity	GHS Category - STOT - Repeated			
	Exposure			
Neurotoxicity	Key Phrases			
Neurotoxicity	GHS H Phrase			
Respiratory Sensitivity/	Asthmagen Type (AOEC Database)		Rs; Rr; Rrs	
Disease				
Respiratory Sensitivity/	Key Phrases		May cause allergy or asthma	
Disease			symptoms or breathing difficulties	
			if inhaled; May cause sensitization	
			by inhalation	
Respiratory Sensitivity/	GHS H Phrase	H335		
Disease				
Respiratory Sensitivity/	GHS Category			
Disease				
Endocrine System	EU - Priority Endocrine Disruptor			
Effects				
Endocrine System	EU - SVHC			
Effects				
Endocrine System	ChemSec - SIN			
Effects				
Endocrine System	OSPAR			
Effects				
Endocrine System	TEDX		Yes	
Effects				
Endocrine System	Key Phrases			
Effects				

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
Other Chronic Organ	Key Phrases		May cause damage to organs;	Causes damage to organs;
Effects			Possible risk of irreversible effects;	Danger of very serious
			May cause damage to organs	irreversible effects; Causes
			through prolonged or repeated	damage to organs through
			exposure	prolonged or repeated exposure;
				Danger of serious damage to
				health by prolonged exposure
Other Chronic Organ	GHS H-Phrase - Single Exposure			
Effects				
Other Chronic Organ	GHS Category - STOT -Single	3		
Effects	Exposure			
Other Chronic Organ	GHS H-Phrase - Repeated			!
Effects	Exposure			
Other Chronic Organ	GHS Category - STOT - Repeated			
Effects	Exposure			
ECOLOGICAL HAZARDS				
Acute Aquatic Toxicity	Acute Fish LC50 (mg/l)	300	45	
Acute Aquatic Toxicity	Acute Algae (or other aquatic plant) EC50 (mg/l)	242	34.6	
Acute Aquatic Toxicity	Key Phrases	No data, but some grounds	Harmful to aquatic life	Not considered harmful to
		for concern		aquatic life
Acute Aquatic Toxicity	GHS H Phrases			
Acute Aquatic Toxicity	GHS Category level	Not Classified		
Chronic Aquatic Toxicity	NOEC (NOAEC) or ECx (mg/l)			
(fish, crustacea or algae)				
- Rapidly Degradable,				
with Adequate Data				
Chronic Aquatic Toxicity	ChV mg/I			
(fish, crustacea or algae)				
- Rapidly Degradable,				
with Adequate Data				
Chronic Aquatic Toxicity	Key Phrases		May be dangerous for the	Not expected to be harmful to
(fish, crustacea or algae)			environment	aquatic life
- Rapidly Degradable,				
with Adequate Data				

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
Chronic Aquatic Toxicity	GHS H Phrases			
(fish, crustacea or algae)				
- Rapidly Degradable,				
with Adequate Data				
Chronic Aquatic Toxicity	GHS Category			
(fish, crustacea or algae)				
- Rapidly Degradable,				
with Adequate Data				
Chronic Aquatic Toxicity	mg/l			
(fish, crustacea or algae)				
- NOT Rapidly				
Degradable, with				
Adequate Data				
Chronic Aquatic Toxicity	Key Phrases			
(fish, crustacea or algae)				
- NOT Rapidly				
Degradable, with				
Adequate Data				
Chronic Aquatic Toxicity	GHS Category level			
(fish, crustacea or algae)				
- NOT Rapidly				
Degradable, with				
Adequate Data				
ENVIRONMENTAL FATE &	TRANSPORT			
Persistence	Water t1/2 Days		8.7	
Persistence	Water Signal Words			
Persistence	Air t1/2 Days		0.89	
Persistence	Air Signal Words			
Persistence	Soil/Sediment t1/2 Days		17.6	
Persistence	Soil/Sediment Signal Words	GHS "rapid degradability"		
Persistence	Key Phrases			Not expected to be persistent
Rapid Degradability	28-day Study: % Breakdown			
	Dissolved Organic Carbon			
Rapid Degradability	28-day Study: % Based on O2 or			
	CO2			
Rapid Degradability	BOD Half-life (days)			
Rapid Degradability	Hydrolysis Half-life (days)			
Rapid Degradability	Key Phrases		Biodegradable	Not Determined

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
Bioconcentration/	Log Kow / Pow	-6.9	-0.92	
Bioaccumulation				
Bioconcentration/	BAF/BCF (I/kg)		0.9	
Bioaccumulation				
Bioconcentration/	On Canada EPA Domestic			
Bioaccumulation	Substances List			
Bioconcentration/	Key Phrases	Not likely/expected to	Will bioaccumulate	Not likely/expected to
Bioaccumulation		bioaccumulate		bioaccumulate
ATMOSPHERIC HAZARDS				
Greenhouse Gas	GWP Relative to CO2		0	0
Greenhouse Gas	Y/N	N	N	N
Ozone Depletor	ODP Units		0	0
Ozone Depletor	GHS H Phrase			
Ozone Depletor	Ozone Classification	Not Classified	Not Classified	Not Classified
Acid Rain Formation	Y/N	N	N	N
Acid Rain Formation	Key Phrases	Does not contain SO2 or NOx	Does not contain SO2 or NOx	Does not contain SO2 or NOx
NESHAP	Y/N		N	N
NESHAP	Key Phrases	Not listed as EPA hazardous air pollutant	Not listed as EPA hazardous air pollutant	Not listed as EPA hazardous air pollutant
PHYSICAL PROPERTIES			4.	•
Vapor Pressure	mm Hg		0.11	
Flammability: Liquid	NFPA/HMIS 0,1,2,3,4		0	0
Flammability: Liquid	GHS H Phrase			
Flammability: Liquid	GHS Category level			
Flash point: Liquid	deg C			
Flash point: Liquid	Key Phrases		No Flash point-will not burn	No Flash point-will not burn
Flammability: Gas	GHS H Phrase			
Flammability: Gas	GHS Category Level			
Reactivity	NFPA/HMIS 0,1,2,3,4		1	0
Reactivity	GHS H Phrase			
Reactivity	GHS Category Level			
рН	pH Units	2-5 or 9-11.5	1-2 or 11.5-14	1-2 or 11.5-14
рН	Key Phrases	Strong acid, caustic	Highly acidic, highly caustic	Strong acid, caustic
Corrosivity	Key Phrases	Corrosive	Highly Corrosive	Mildly corrosive
Corrosivity	GHS Category Level			
Odor	Key Phrases	Slight odor	Odorless	Odorless

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
Volatile Organic	g/l		45	86
Compound				
PROCESS FACTORS	·		-	-
Heat	WBGT, deg C			
Noise Generation	dBA/hr			
Vibration	Class 1 Small Machine (mm/s)			
Vibration	Class 2 Medium Machine (mm/s)			
Vibration	Class 3 Large Rigid Foundation (mm/s)			
Vibration	Class 4 Large Soft Foundation (mm/s)			
Ergonomic Hazard	Occurence	Unlikely/ remote	Possible	Unlikely/ remote
Ergonomic Hazard	Hazard Level	Minor injury/illness, minor impact on time lost	Moderate injury, lost time	Moderate injury, lost time
Psychosocial Hazard	Work Overload and Pace: Work Load			
Psychosocial Hazard	Work Overload and Pace: Machine Pacing			
Psychosocial Hazard	Work Overload and Pace: Time Constraints			
Psychosocial Hazard	Work Schedule: Shift Work			
Psychosocial Hazard	Work Schedule: Work Isolation		Process requires restricted access	Process eliminates isolation work
Psychosocial Hazard	Control		Process provides worker with access to supervisor about needed changes	Process allows for minor changes in real-time by worker
Psychosocial Hazard	Work Environment & Equipment: Equipment Stability			
Psychosocial Hazard	Work Environment & Equipment: Work Space			
High Pressure System	Pressure (Delta % Change From Ambient)		0	0
High Temperature	Temperature (Delta % Change		0	25
System	From Ambient)			
Water Use	% Water Change			
Water Use	Reuse			
Energy Use	% Energy Change	25% reduction		
Energy Use	% Renewable Energy			
Exposure Potential	Occurence: Near Certain			

Category	Units	Powder Keg	Veracity Caustic Cleaner	Liquid Metal Safe
Exposure Potential	Occurence: Highly Likely	Minor hazard		
Exposure Potential	Occurence: Likely		Critical hazard	Marginal hazard
Exposure Potential	Occurence: Unlikely			
Exposure Potential	Occurence: Remote			
LIFE CYCLE FACTORS	-	•	-	-
Upstream Effects	Key Phrases		Process reduces suppliers use of hazardous materials, energy, water and other resources	Eliminates suppliers use of hazardous materials or reduces use of energy, water, and resources
Consumer Hazard	Key Phrases	Product contains hazardous components with no consumer exposure potential	Product contains hazardous components with low consumer exposure potential	Product contains hazardous components with low consumer exposure potential
Disposal Hazard (landfill, incineration)	Key Phrases	Prevents/ reduces amount of waste material being created	Creates concern for air, water or land and disposed of as hazardous waste	Creates concern for air, water or land and disposed of as hazardous waste
Reportable Quantity	Pounds			
Recycling	% Recyclable at End of Life			
Recycling	Uses Products With % Recycled Material			
Renewable to Nonrenewable Resource	% Renewable Materials			
Renewable to Nonrenewable Resource	Key Words			

Alternative Cleaners

Category	Units	Neutral CIP Detergent LFE	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
ACUTE HUMAN EFFECTS	S					
Inhalation Toxicity	LC50 ppm					12.6
Inhalation Toxicity	Vapor GHS Category Level					
Inhalation Toxicity	mg/l gas/vapor					
Inhalation Toxicity	mg/l dust/mist/fume					
Inhalation Toxicity	Key Phrases		May cause breathing difficulties if inhaled	Not considered harmful	Not considered harmful	May cause breathing difficulties if inhaled
Inhalation Toxicity	Solid GHS Category Level					
Inhalation Toxicity	GHS H Phrases					
Oral Toxicity	LD50 mg/kg	20000	2000	2000	5000	
Oral Toxicity	Key Phrases	Not harmful if swallowed	May be harmful if swallowed	Not harmful if swallowed		May be harmful if swallowed
Oral Toxicity	GHS H Phrases					
Oral Toxicity	GHS Category Level					
Dermal Toxicity	LD50 mg/kg	20800				
Dermal Toxicity	Key Phrases	Not harmful if comes in contact with skin	May be harmful	Not harmful if comes in contact with skin	Not harmful if comes in contact with skin	May be harmful
Dermal Toxicity	GHS H Phrases					
Dermal Toxicity	GHS Category Level					
Respiratory Irritation	Key Phrases	Evidence in humans and animals shows slight or minor reversible respiratory irritation effects	Evidence in humans and animals shows slight or minor reversible respiratory irritation effects	Non-irritating; Adequate data available, and negative studies, no structural alerts, and GHS not classified.		
Respiratory Irritation	GHS H Phrases	H335				
Respiratory Irritation	GHS Category Level					1

Category	Units	Neutral CIP Detergent LFE	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
Dermal Irritation	Key Phrases		Slight or minor reversible skin irritation effects	Non-irritating; Adequate data available, and negative studies, no structural alerts, and GHS not classified.	Non-irritating; Adequate data available, and negative studies, no structural alerts, and GHS not classified.	Slight or minor reversible skin irritation effects
Dermal Irritation	GHS Category Level					3
Dermal Irritation	GHS H Phrases					
Eye Irritation	Key Phrases	Mild reversible eye irritation effects; Mildly irritating	Slight or minor reversible eye irritation effects	Non-irritating; Adequate data available, and negative studies, no structural alerts, and GHS not classified.	Reversible irritation effects on the eyes from single or repeated exposure; Irritating	Mild reversible eye irritation effects; Mildly irritating
Eye Irritation	GHS H Phrases				H319	H320
Eye Irritation	GHS Category Level				2A	2, 2B
Exposure Limits	PEL/TLV ppm					0.1
Exposure Limits	PEL/TLV (dusts/particles) mg/m3					
Exposure Limits	GHS Category Level					
IDLH	ppm					5
Health	NFPA/HMIS 0,1,2,3,4	1	0	1	2	2
CHRONIC HUMAN EF	FECTS					
Carcinogen	IARC Category					
Carcinogen	EPA CLASS Category					
Carcinogen	ACGIH Category					
Carcinogen	OSHA Category	No components are listed as carcinogens by OSHA	No components are listed as carcinogens by OSHA	No components are listed as carcinogens by OSHA		No components are listed as carcinogens by OSHA

Category	Units	Neutral CIP	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
		Detergent LFE				
Carcinogen	Key Phrases	No component present at greater than or equal to 0.1% as probable, possible or confirmed human carcinogen	No component present at greater than or equal to 0.1% as probable, possible or confirmed human carcinogen	No component present at greater than or equal to 0.1% as probable, possible or confirmed human carcinogen	No component present at greater than or equal to 0.1% as probable, possible or confirmed human carcinogen	No component present at greater than or equal to 0.1% as probable, possible or confirmed human carcinogen
Carcinogen	GHS H Phrases					J
Carcinogen	GHS Category					
Carcinogen	Prop 65 Category					
Mutagen/ Teratogen	Key Phrases	Not expected to be mutagenic in humans	Tested with no signs of mutagenicity		Not expected to be mutagenic in humans	
Mutagen/ Teratogen	GHS H Phrase					
Mutagen/ Teratogen	GHS Category					
Reproductive/ Developmental	Key Phrases	Not expected to have reproductive effects	Tested with no signs of reproductive/ development toxicity		Not expected to have reproductive effects	
Reproductive/ Developmental	GHS H Phrases					
Reproductive/ Developmental	GHS Category					
Reproductive/ Developmental	Prop 65 Category					
Neurotoxicity	GHS Category - STOT - Single Exposure					
Neurotoxicity	GHS Category - STOT - Repeated Exposure					
Neurotoxicity	Key Phrases					
Neurotoxicity	GHS H Phrase					
Respiratory Sensitivity/ Disease	Asthmagen Type (AOEC Database)					

Category	Units	Neutral CIP Detergent LFE	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
Respiratory Sensitivity/	Key Phrases	May cause	May cause	Known to not cause		May cause
Disease		respiratory irritation	respiratory irritation	respiratory		respiratory
				sensitization; Only		irritation
				negative test results		
Respiratory Sensitivity/ Disease	GHS H Phrase	H335				
Respiratory Sensitivity/ Disease	GHS Category					
Endocrine System	EU - Priority Endocrine					
Effects	Disruptor					
Endocrine System Effects	EU - SVHC					
Endocrine System Effects	ChemSec - SIN					
Endocrine System Effects	OSPAR					
Endocrine System Effects	TEDX	Yes				
Endocrine System	Key Phrases					
Effects						
Other Chronic Organ Effects	Key Phrases					
Other Chronic Organ Effects	GHS H-Phrase - Single Exposure					
Other Chronic Organ	GHS Category - STOT -	Substance/mixture	Substance/mixture	Substance/mixture		
Effects	Single Exposure	not classified as	not classified as	not classified as		
		STOT, single	STOT, single	STOT, single		
		exposure.	exposure.	exposure.		
Other Chronic Organ Effects	GHS H-Phrase - Repeated Exposure					
Other Chronic Organ	GHS Category - STOT -	Substance/mixture	Substance/mixture	Substance/mixture		
Effects	Repeated Exposure	not classified as	not classified as	not classified as		
		STOT, repeated	STOT, repeated	STOT, repeated		
		exposure.	exposure.	exposure.		
ECOLOGICAL HAZARDS						
Acute Aquatic Toxicity	Acute Fish LC50 (mg/l)	45	597		31400	

Category	Units	Neutral CIP Detergent LFE	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
Acute Aquatic Toxicity	Acute Algae (or other	19000	126		23300	
	aquatic plant) EC50					
	(mg/l)					
Acute Aquatic Toxicity	Key Phrases	Harmful to aquatic	Not considered	Not considered	Not considered	Very toxic to
		life	harmful to aquatic	harmful to aquatic	harmful to	aquatic life
			life	life	aquatic life	
Acute Aquatic Toxicity	GHS H Phrases					H400
Acute Aquatic Toxicity	GHS Category level					Acute 1
Chronic Aquatic Toxicity	NOEC (NOAEC) or ECx					
(fish, crustacea or algae)	(mg/l)					
- Rapidly Degradable,						
with Adequate Data	GIV /I	4.44	24.54		20550	225
Chronic Aquatic Toxicity	ChV mg/I	1.44	24.51		28660	235
(fish, crustacea or algae)						
- Rapidly Degradable,						
with Adequate Data						
Chronic Aquatic Toxicity	Key Phrases	May be dangerous	Not harmful to	Not expected to be	Not harmful to	Not expected to
(fish, crustacea or algae)		for the environment	aquatic life	harmful to aquatic	aquatic life	be harmful to
- Rapidly Degradable,				life		aquatic life
with Adequate Data	CUCUR					
Chronic Aquatic Toxicity	GHS H Phrases					
(fish, crustacea or algae)						
- Rapidly Degradable, with Adequate Data						
Chronic Aquatic Toxicity	GHS Category					
(fish, crustacea or algae)	GIIS Category					
- Rapidly Degradable,						
with Adequate Data						
Chronic Aquatic Toxicity	mg/l					
(fish, crustacea or algae)	1116/1					
- NOT Rapidly						
Degradable, with						
Adequate Data						
Chronic Aquatic Toxicity	Key Phrases					
(fish, crustacea or algae)	,					
- NOT Rapidly						
Degradable, with						
Adequate Data						

Category	Units	Neutral CIP Detergent LFE	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data	GHS Category level					
ENVIRONMENTAL FATE 8	k TRANSPORT					
Persistence	Water t1/2 Days	15			8.7	15
Persistence	Water Signal Words					
Persistence	Air t1/2 Days	0.89			1.25	0.15
Persistence	Air Signal Words					
Persistence	Soil/Sediment t1/2 Days	30			17.4	30
Persistence	Soil/Sediment Signal Words					
Persistence	Key Phrases	Not expected to be persistent	Not expected to be persistent	Not persistent		Not persistent
Rapid Degradability	28-day Study: % Breakdown Dissolved Organic Carbon					
Rapid Degradability	28-day Study: % Based on O2 or CO2					
Rapid Degradability	BOD Half-life (days)					
Rapid Degradability	Hydrolysis Half-life (days)					
Rapid Degradability	Key Phrases	Biodegradable	Biodegradable	Biodegradable	Biodegradable	Readily degradable
Bioconcentration/ Bioaccumulation	Log Kow / Pow	3.01	-0.46		-1.64	-0.87
Bioconcentration/ Bioaccumulation	BAF/BCF (I/kg)	71.36	1.09		0.89	0.9
Bioconcentration/ Bioaccumulation	On Canada EPA Domestic Substances List					
Bioconcentration/	Key Phrases	Not likely/expected	Will not	Not likely/expected		Will not
Bioaccumulation		to bioaccumulate	bioaccumulate	to bioaccumulate		bioaccumulate
ATMOSPHERIC HAZARD						
Greenhouse Gas	GWP Relative to CO2	0	0	0	0	0
Greenhouse Gas	Y/N	N	N	N	N	N

Category	Units	Neutral CIP Detergent LFE	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
Ozone Depletor	ODP Units	0	0	0	0	0
Ozone Depletor	GHS H Phrase					
Ozone Depletor	Ozone Classification	Not Classified	Not Classified	Not Classified	Not Classified	Not Classified
Acid Rain Formation	Y/N	N	N	N		N
Acid Rain Formation	ormation Key Phrases Does no or NOx		Does not contain SO2 or NOx	Does not contain SO2 or NOx	Product may form SO2 or NOx upon combustion	Does not contain SO2 or NOx
NESHAP	Y/N	N	N	N	N	Υ
NESHAP	Key Phrases	Not listed as EPA hazardous air pollutant	Not listed as EPA hazardous air pollutant	Not listed as EPA hazardous air pollutant	Not listed as EPA hazardous air pollutant	Listed as EPA hazardous air pollutant
PHYSICAL PROPERTIES	•					
Vapor Pressure	mm Hg	6.99			0.01	
Flammability: Liquid	NFPA/HMIS 0,1,2,3,4	0	0	0	0	0
Flammability: Liquid	GHS H Phrase					
Flammability: Liquid	GHS Category level					
Flash point: Liquid	deg C					
Flash point: Liquid	Key Phrases	No Flash point-will not burn	No Flash point-will not burn	No Flash point-will not burn	No Flash point- will not burn	No Flash point- will not burn
Flammability: Gas	GHS H Phrase					
Flammability: Gas	GHS Category Level					
Reactivity	NFPA/HMIS 0,1,2,3,4	0	0	0	0	3
Reactivity	GHS H Phrase					
Reactivity	GHS Category Level					
pH	pH Units	2-5 or 9-11.5	5-6 or 8-9	6-7 or 7-8	2-5 or 9-11.5	2-5 or 9-11.5
рН	Key Phrases	Acidic, alkaline	Mildly acidic, mildly alkaline	Mildly acidic, mildly alkaline	Acidic, alkaline	
Corrosivity	Key Phrases	Not corrosive	Not corrosive	Not corrosive	Mildly corrosive	
Corrosivity	GHS Category Level				,	
Odor	Key Phrases	Odorless	Slight odor	Mild odor	Mild odor	Pungent or irritating odor
Volatile Organic Compound	g/l	45	0		25	0
PROCESS FACTORS						
Heat	WBGT, deg C					
Noise Generation	dBA/hr		80/no limit			

Category	Units	Neutral CIP	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
		Detergent LFE				
Vibration	Class 1 Small Machine (mm/s)		1			
Vibration	Class 2 Medium Machine (mm/s)					
Vibration	Class 3 Large Rigid Foundation (mm/s)					
Vibration	Class 4 Large Soft Foundation (mm/s)					
Ergonomic Hazard	Occurence	Unlikely/ remote	Possible	Unlikely/ remote	Unlikely/ remote	Possible
Ergonomic Hazard	Hazard Level	Minor injury/illness, minor impact on time lost	Minor injury/illness, minor impact on time lost	Insignificant, no injury, no impact on time	Minor injury/illness, minor impact on time lost	Minor injury/illness, minor impact on time lost
Psychosocial Hazard	Work Overload and Pace: Work Load					
Psychosocial Hazard	Work Overload and Pace: Machine Pacing					
Psychosocial Hazard	Work Overload and Pace: Time Constraints					
Psychosocial Hazard	Work Schedule: Shift Work					
Psychosocial Hazard	Work Schedule: Work Isolation	Process eliminates isolation work	Process eliminates isolation work	Process eliminates isolation work	Process eliminates isolation work	Process requires restricted access
Psychosocial Hazard	Control	Process allows for minor changes in real-time by worker	Process includes worker input	Process allows for minor changes in real-time by worker	Process allows for minor changes in real- time by worker	Process provides worker with access to supervisor about needed changes
Psychosocial Hazard	Work Environment & Equipment: Equipment Stability		Improved equipment quality and suitability			
Psychosocial Hazard	Work Environment & Equipment: Work Space					
High Pressure System	Pressure (Delta % Change From Ambient)	0	0	0	0	0
High Temperature System	Temperature (Delta % Change From Ambient)	0	0	15	15	0

Category	Units	Neutral CIP	Force of Nature	Surface Cleanse 930	Micro A07	Ozone
		Detergent LFE				
Water Use	% Water Change					
Water Use	Reuse					
Energy Use	% Energy Change		25% increase			
Energy Use	% Renewable Energy					
Exposure Potential	Occurence: Near Certain					
Exposure Potential	Occurence: Highly Likely					
Exposure Potential	Occurence: Likely	Marginal hazard	Minor hazard	Minor hazard	Marginal hazard	Marginal hazard
Exposure Potential	Occurence: Unlikely					
Exposure Potential	Occurence: Remote					
LIFE CYCLE FACTORS	_					
Upstream Effects	Key Phrases	Eliminates suppliers use of hazardous materials or reduces use of energy, water, and resources	Eliminates suppliers use of hazardous materials or reduces use of energy, water, and resources	Eliminates suppliers use of hazardous materials and reduces use of energy, water, and resources	Eliminates suppliers use of hazardous materials and reduces use of energy, water, and resources	Process reduces suppliers use of hazardous materials, energy, water and other resources
Consumer Hazard	Key Phrases	Product contains hazardous components with no consumer exposure potential	Product contains hazardous components with no consumer exposure potential	Product contains no hazardous components	Product contains no hazardous components	Product contains hazardous components with low consumer exposure potential
Disposal Hazard (landfill, incineration)	Key Phrases	Creates some concern for air, water or land	Prevents/ reduces amount of waste material being created	Creates some concern for air, water or land	Prevents/ reduces amount of waste material being created	Creates some concern for air, water or land
Reportable Quantity	Pounds					100
Recycling	% Recyclable at End of Life					
Recycling	Uses Products With % Recycled Material					
Renewable to Nonrenewable Resource	% Renewable Materials					
Renewable to Nonrenewable Resource	Key Words					

Baseline & Alternative Sanitizers

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
ACUTE HUMAN EFFE	стѕ							
Inhalation Toxicity	LC50 ppm							12.6
Inhalation Toxicity	Vapor GHS Category Level							
Inhalation Toxicity	mg/l gas/vapor		0.3					
Inhalation Toxicity	mg/l dust/mist/fu me							
Inhalation Toxicity	Key Phrases	Harmful if inhaled	Harmful if inhaled	May cause breathing difficulties if inhaled	Not considered harmful	May cause breathing difficulties if inhaled	May cause breathing difficulties if inhaled	May cause breathing difficulties if inhaled
Inhalation Toxicity	Solid GHS Category Level							
Inhalation Toxicity	GHS H Phrases							
Oral Toxicity	LD50 mg/kg		263	2000	3730	10000		
Oral Toxicity	Key Phrases	Harmful if swallowed	Harmful if swallowed	May be harmful if swallowed		Harmful if swallowed	Harmful if swallowed	May be harmful if swallowed
Oral Toxicity	GHS H Phrases						H302	
Oral Toxicity	GHS Category Level						4	
Dermal Toxicity	LD50 mg/kg		1060		2000	2000		
Dermal Toxicity	Key Phrases	Harmful in contact with skin		May be harmful		May be harmful	Harmful in contact with skin	May be harmful
Dermal Toxicity	GHS H Phrases							
Dermal Toxicity	GHS Category Level						1	

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Respiratory	Key Phrases	Evidence in	Evidence in	Evidence in	Non-irritating;	Evidence in	Evidence in	
Irritation		humans or	humans or	humans and	Adequate	humans and	humans and	
		animals shows	animals shows	animals shows	data available,	animals shows	animals shows	
		mild	mild reversible	slight or minor	and	slight or minor	slight or minor	
		reversible	respiratory	reversible	negative	reversible	reversible	
		respiratory	irritation	respiratory	studies, no	respiratory	respiratory	
		irritation	effects; Low to	irritation effects	structural	irritation	irritation	
		effects; Low to	moderate		alerts, and	effects	effects	
		moderate	frequency of		GHS not			
		frequency of	occurrence		classified.			
		occurrence						
Respiratory	GHS H	H335						
Irritation	Phrases							_
Respiratory	GHS Category							1
Irritation	Level							
Dermal Irritation	Key Phrases	Reversible	Existing human	Slight or minor	Reversible	Reversible skin	Reversible	Slight or
		skin irritation	and animal	reversible skin	skin irritation	irritation	skin irritation	minor
		effects;	data, in vitro	irritation effects	effects;	effects; Irritant	effects;	reversible skin
		Irritant	data or		Irritant		Irritant	irritation
			information					effects
			from					
			structurally					
			related					
			compounds shows					
			irreversible skin					
			burns; Corrosive					
Dermal Irritation	CHC Catagory		•		10.2	1B	1	3
	GHS Category Level		1A, 1		1C, 2		1A, 1	3
Dermal Irritation	GHS H Phrases	H315	H314		H315	H315	H314	

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Eye Irritation	Key Phrases	Reversible	Existing human	Slight or minor	Reversible	Reversible	Existing	Mild
		irritation	and animal	reversible eye	irritation	irritation	human and	reversible eye
		effects on the	data, in vitro	irritation effects	effects on the	effects on the	animal data,	irritation
		eyes from	data or		eyes from	eyes from	in vitro data	effects; Mildly
		single or	information		single or	single or	or information	irritating
		repeated	from		repeated	repeated	from	
		exposure;	structurally		exposure;	exposure;	structurally	
		Irritating	related		Irritating	Irritating	related	
			compounds				compounds	
			shows				shows irreversible	
			irreversible eye damage;				eye damage;	
			Irreversible				Irreversible	
Eye Irritation	GHS H	H319	H318, H314		H319	H318, H314	H318, H314	H320
	Phrases		,				·	
Eye Irritation	GHS Category	2A	1		1	1	1	2, 2B
	Level							
Exposure Limits	PEL/TLV ppm		1					0.1
Exposure Limits	PEL/TLV	1	1					
	(dusts/particl							
F 11 11	es) mg/m3							
Exposure Limits	GHS Category							
IDIII	Level		50					-
IDLH	ppm	2	50	0		2		5
Health	NFPA/HMIS 0,1,2,3,4	3	3	0	3	3		2
CHRONIC HUMAN E			<u> </u>			<u> </u>		
		1.	1.				1.	
Carcinogen	IARC	4	4				4	
•	Category						_	
Carcinogen	EPA CLASS						E	
Canalinana	Category		A.F.				Α.Γ.	
Carcinogen	ACGIH		A5				A5	
Carcinagan	Category OSHA	No	No components	No components	No	No	No	No
Carcinogen	Category	components	No components are listed as	No components are listed as	components	components	components	components
	Category	are listed as	carcinogens by	carcinogens by	are listed as	are listed as	are listed as	are listed as
		carcinogens	OSHA	OSHA	carcinogens	carcinogens by	carcinogens	carcinogens
		by OSHA	55117	JOSTIA	by OSHA	OSHA	by OSHA	by OSHA

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Carcinogen	Key Phrases	No	No component	No component	No	No component	No	No
		component	present at	present at greater	component	present at	component	component
		present at	greater than or	than or equal to	present at	greater than or	present at	present at
		greater than	equal to 0.1% as	0.1% as probable,	greater than	equal to 0.1%	greater than	greater than
		or equal to	probable,	possible or	or equal to	as probable,	or equal to	or equal to
		0.1% as	possible or	confirmed human	0.1% as	possible or	0.1% as	0.1% as
		probable,	confirmed	carcinogen	probable,	confirmed	probable,	probable,
		possible or	human		possible or	human	possible or	possible or
		confirmed	carcinogen		confirmed	carcinogen	confirmed	confirmed
		human			human		human	human
		carcinogen			carcinogen		carcinogen	carcinogen
Carcinogen	GHS H Phrases							
Carcinogen	GHS Category							
Carcinogen	Prop 65						No; not listed	
	Category						on prop 65	
Mutagen/	Key Phrases	Not expected		Tested with no				
Teratogen		to be		signs of				
		mutagenic in		mutagenicity				
		humans						
Mutagen/	GHS H Phrase							
Teratogen								
Mutagen/	GHS Category							
Teratogen	., -1							
Reproductive/	Key Phrases	Not expected		Tested with no				
Developmental		to have		signs of				
		reproductive		reproductive/				
		effects		development				
Daniel /	CHCH			toxicity				
Reproductive/	GHS H							
Developmental	Phrases							
Reproductive/	GHS Category							
Developmental Page dusting /	Dran CF						No. not lists -	
Reproductive/	Prop 65						No; not listed	
Developmental	Category	I					on prop 65	

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Neurotoxicity	GHS Category - STOT - Single Exposure							
Neurotoxicity	GHS Category - STOT - Repeated Exposure							
Neurotoxicity	Key Phrases							
Neurotoxicity	GHS H Phrase							
Respiratory Sensitivity/ Disease	Asthmagen Type (AOEC Database)		Rs; Rr; Rrs					
Respiratory Sensitivity/ Disease	Key Phrases	May cause respiratory irritation	Sensitizer; Asthmagen; Substances showing a high frequency of occurrence in humans; probability of occurrence of a high sensitization rate in humans based on animals or other tests	May cause respiratory irritation		May cause respiratory irritation		May cause respiratory irritation
Respiratory Sensitivity/ Disease	GHS H Phrase							
Respiratory Sensitivity/ Disease	GHS Category							
Endocrine System Effects	EU - Priority Endocrine Disruptor							
Endocrine System Effects	EU - SVHC							

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Endocrine System	ChemSec -							
Effects	SIN							
Endocrine System	OSPAR							
Effects								
Endocrine System Effects	TEDX							
Endocrine System Effects	Key Phrases							
Other Chronic Organ Effects	Key Phrases	May cause damage to organs; Possible risk of irreversible effects; May cause damage to organs through prolonged or repeated exposure						
Other Chronic	GHS H-Phrase	скрозате						
Organ Effects	- Single Exposure							
Other Chronic Organ Effects	GHS Category - STOT -Single Exposure		3	Substance/mixture not classified as STOT, single exposure.				
Other Chronic Organ Effects	GHS H-Phrase - Repeated Exposure							
Other Chronic	GHS Category			Substance/mixture				
Organ Effects	- STOT -			not classified as				
	Repeated			STOT, repeated				
	Exposure			exposure.				
ECOLOGICAL HAZAR	DS							
Acute Aquatic	Acute Fish	8.47	16.4	597	160	110	0.28	
Toxicity	LC50 (mg/l)							

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Acute Aquatic	Acute Algae	13.41	2.5	126	3500		0.88	
Toxicity	(or other							
	aquatic plant)							
	EC50 (mg/l)							
Acute Aquatic	Key Phrases	Harmful to		Not considered	Not	Not	Very toxic to	Very toxic to
Toxicity		aquatic life		harmful to aquatic	considered	considered	aquatic life	aquatic life
				life	harmful to	harmful to		
					aquatic life	aquatic life		
Acute Aquatic	GHS H						H400	H400
Toxicity	Phrases							
Acute Aquatic	GHS Category						Acute 1	Acute 1
Toxicity	level							
Chronic Aquatic	NOEC							
Toxicity (fish,	(NOAEC) or							
crustacea or algae) -	ECx (mg/l)							
Rapidly Degradable,								
with Adequate Data								
Chronic Aquatic	ChV mg/l	1.12	493	24.51			48.9	235
Toxicity (fish,								
crustacea or algae) -								
Rapidly Degradable,								
with Adequate Data								
Chronic Aquatic	Key Phrases	May be		Not harmful to	Not harmful	Toxic to	Toxic to	Not expected
Toxicity (fish,		dangerous for		aquatic life	to aquatic life	aquatic life	aquatic life	to be harmful
crustacea or algae) -		the				with long	with long	to aquatic life
Rapidly Degradable,		environment				lasting effects	lasting effects	
with Adequate Data								
Chronic Aquatic	GHS H						H410	
Toxicity (fish,	Phrases							
crustacea or algae) -								
Rapidly Degradable,								
with Adequate Data								
Chronic Aquatic	GHS Category						Chronic 1	
Toxicity (fish,								
crustacea or algae) -								
Rapidly Degradable,								
with Adequate Data								

be persistent to be persistent to be persistent persistent degradation/hazardous	Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Crustace or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Developmental Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Developmental Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Developmental Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Developmental Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Developmental Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data Developmental Toxicity (fish, crustacea or algae) NoT Rapidly Degradable, with Adequate Data D	Chronic Aquatic	mg/l							
NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT ENVIRONMENTAL FATE & TRANSPORT Persistence Water signal Words Persistence Air t.j. Z Days 0.65 14.5 2.7 1.9 3.55 0.15 Persistence Air signal Words Persistence Soli/Sedimen 1 t.j. Z Days 1.17 1.7 30 30 30 Persistence Soli/Sedimen 1 t.j. Z Days 1.17 1.7 30 30 30 Persistence Soli/Sedimen 1 t.j. Z Days 1.17 1.7 30 30 30 Persistence Soli/Sedimen 1 t.j. Z Days 1.17 1.7 30 30 30 Persistence Soli/Sedimen 1 t.j. Z Days 1.17 1.17 30 30 30 Persistence Soli/Sedimen 1 t.j. Z Days 1.17 1.17 30 30 30 Persistence Soli/Sedimen 1 t.j. Z Days 30 30 30 30 30 30 30 30 30 30 30 30 30	Toxicity (fish,								
Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Persistence Water \$1/2 Days Persistence Water \$1/2 Days Persistence Air \$1/2 Days Air \$1/2 Days Persistence Soil/Sedimen t \$1/2 Days Persistenc	crustacea or algae) -								
Adequate Data Chronic Aquatic Chroxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Dosic Tylish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Evistence Water 11/2 Days Persistence Water Signal Words Persistence Air 15 15 8.7 8.7 8.7 15 15 15 Persistence Air Signal Words Persistence Soil/Sedimen t Signal Words Not expected to be persistent be persistent Not expected to be persistent be persistent DNot expected to be persistent be persistent Province of the persistent be persistent be persistent DNot expected to be persistent be persistent DNot expected to DNot expected to DNot expected to	NOT Rapidly								
Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT	Degradable, with								
Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Erristence Water 11/2 Days Persistence Water Signal Words Persistence Air 11/2 Days O.65 14.5 Persistence Air Signal Words Persistence Soil/Sedimen t Signal Words Persistence Rey Phrases Rey Phrases Rey Phrases Not expected to be persistent Persistence Not expected to be persistent Persistence to be persistent Persistence be persistent Position Position Persistence Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Persistence Rey Phrases Rey Phr	Adequate Data								
crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data BY STAND Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Persistence Water t1/2 Days Persistence Air t1/2 Days Persistence Air t1/2 Days Persistence Soli/Sedimen t Signal Words Not expected to be persistent Not expected to be persistent Persistence Soli/Sedimen t Signal Words Not expected to be persistent Soli be environ- mental degradation/ hazardous Abazardous Abazardo	Chronic Aquatic	Key Phrases							
NOT Rapidly Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Persistence Water Signal Words Persistence Air Signal Words Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Rey Phrases Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Rey Phrases Persistence Persistence Rey Phrases Persistence Rey Phrases Persistence Persistence Rey Phrases Persistence Persistence Rey Phrases Persistence	Toxicity (fish,								
Degradable, with Adequate Data Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidhy Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Persistence Water 11/2 Days Persistence Air 11/2 Days Persistence Air Signal Words Persistence Soil/Sedimen t Signal Words Pe	crustacea or algae) -								
Adequate Data Chronic Aquatic Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPOT Persistence Water t1/2 Days Persistence Water Signal Words Persistence Air Signal Woords Persistence Soil/Sedimen t 1/2 Days Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words P	NOT Rapidly								
Adequate Data Chronic Aquatic Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPOT Persistence Water t1/2 Days Persistence Water Signal Words Persistence Air Signal Woords Persistence Soil/Sedimen t 1/2 Days Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words P	Degradable, with								
Chronic Aquatic Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Persistence Water 1/2 Days Persistence Air 1/2 Days Persistence Air 1/2 Days Persistence Soli/Sedimen t 1/1/2 Days Persistence Soli/Sedimen t Signal Words Persistence Soli/Sedimen t Signal Words Persistence Soli/Sedimen t Signal Persistence Soli/Sedimen t Signal Persistence Pers									
Toxicity (fish, crustacea or algae) - NOT Rapidly Degradable, with Adequate Data Persistence Water 11/2 Days Degradable Words Degradable Degradable Days		GHS Category							
crustacea or algae) - NOT Rapidly Degradable, with Adequate Data ENVIRONMENTAL FATE & TRANSPORT Persistence Water Signal Words Persistence Air 1/2 Days O.65 14.5 2.7 1.9 3.55 0.15 Persistence Air Signal Words Persistence Soil/Sedimen t Signal Words Persistence Not expected to be persistent	•								
NOT Rapidly Degradable, with Adequate Data Adequate Data ENVIRONMENTAL FATE & TRANSPORT Persistence Water 11/2 Days Persistence Water Signal Words Persistence Air 11/2 Days Persistence Air Signal Words Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence As Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence As Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Wo									
Degradable, with Adequate Data Service Adequate Data Service Servi									
Adequate Data Image: Company of the persistence of the persist									
Persistence Water t1/2 Days 15 15 15 15 15 15 15 15 15 15 15 15 15									
Persistence Water Signal Words Persistence Air t1/2 Days 0.65 14.5 2.7 1.9 3.55 0.15 Persistence Air Signal Words Persistence Soil/Sedimen t Signal Words Persistence Key Phrases Not expected to be persistent degradation/ hazardous	ENVIRONMENTAL FA	TE & TRANSPOR	Т	<u>'</u>	<u>'</u>	-	<u> </u>	-	-
Persistence Water Signal Words 2.7 1.9 3.55 0.15 Persistence Air 1/2 Days 0.65 14.5 2.7 1.9 3.55 0.15 Persistence Soil/Sedimen t 1/2 Days 2.0 30 30 30 30 30 30 30 30 30 30 30 30 30	Persistence	Water t1/2	15	15		8.7	8.7	15	15
Persistence Air t1/2 Days 0.65 14.5 2.7 1.9 3.55 0.15 Persistence Soil/Sedimen t t1/2 Days Soil/Sedimen t Signal Words Soil/Sedimen t Signal		Days							
Persistence Air t1/2 Days 0.65 14.5 2.7 1.9 3.55 0.15 Persistence Air Signal Words Persistence Soil/Sedimen t t1/2 Days Persistence Soil/Sedimen t Signal Words Persistence Hollow Formula to be persistent degradation/ hazardous	Persistence	Water Signal							
Persistence Air Signal Words Persistence Soil/Sedimen t t1/2 Days Persistence Soil/Sedimen t Signal Words Persistence Key Phrases Persistence Key Phrases Fersistent Signal Words Persistence Key Phrases Fersistent Signal Words Not expected to be persistent to be persistent degradation/ hazardous		_							
Persistence Air Signal Words Persistence Soil/Sedimen t t1/2 Days Persistence Soil/Sedimen t Signal Words Persistence Soil/Sedimen t Signal Words Persistence Key Phrases Fersistence Region and the persistent Signal Words Not expected to be persistent to be persistent be persistent persistent degradation/ hazardous	Persistence	Air t1/2 Days	0.65	14.5		2.7	1.9	3.55	0.15
Persistence Soil/Sedimen t t1/2 Days Soil/Sedimen t Signal Words									
Persistence Soil/Sedimen t t1/2 Days Persistence Soil/Sedimen t Signal Words Persistence Key Phrases Not expected to be persistent to be persistent persistent degradation/ hazardous Soil/Sedimen t Signal Words Not expected to be persistent persistent degradation/ hazardous		_							
Persistence Soil/Sedimen t Signal Words Persistence Key Phrases Rey Phrases Persistent	Persistence		30	30		17	17	30	30
Persistence Soil/Sedimen t Signal Words Persistence Key Phrases Key Phrases Not expected to be persistent to be persistent persistent persistent degradation/ hazardous									
t Signal Words Persistence Key Phrases Not expected to be persistent be persistent Not expected to be persistent to be persistent persistent persistent Not expected to be persistent hazardous	Persistence								
Persistence Key Phrases Not expected to be persistent to be persistent persistent degradation/ hazardous									
Persistence Key Phrases Not expected to be persistent to be persistent persistent degradation/ hazardous Not expected to be persistent persistent persistent degradation/ hazardous									
be persistent to be persistent to be persistent to be persistent persistent degradation/hazardous	Persistence				Not expected to	Not expected	Not expected	Slow environ-	Not persistent
persistent persistent degradation/ hazardous	-	-,				·	•		
hazardous									
						,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	50.0.000	•	
degradation								degradation	
products form								_	

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Rapid Degradability	28-day Study: % Breakdown Dissolved					88		
	Organic Carbon							
Rapid Degradability	28-day Study: % Based on O2 or CO2							
Rapid Degradability	BOD Half-life (days)							
Rapid Degradability	Hydrolysis Half-life (days)							
Rapid Degradability	Key Phrases	Biodegradable	Biodegradable	Biodegradable	Readily degradable	Readily degradable	Not Determined	Readily degradable
Bioconcentration/ Bioaccumulation	Log Kow / Pow	4.78	-0.17	-0.46	-0.62	3.05	-0.06	-0.87
Bioconcentration/ Bioaccumulation	BAF/BCF (I/kg)	508.9	0.95	1.09	3.2	3.2	1.28	0.9
Bioconcentration/ Bioaccumulation	On Canada EPA Domestic Substances List							
Bioconcentration/ Bioaccumulation	Key Phrases	Potential to bioaccumulate		Will not bioaccumulate	Will not bioaccumulate	Not likely/expected to bioaccumulate	Will not bioaccumulate	Will not bioaccumulate
ATMOSPHERIC HAZA	RD							
Greenhouse Gas	GWP Relative to CO2	0	0	0	0	0	0	0
Greenhouse Gas	Y/N	N	N	N	N	N	N	N
Ozone Depletor	ODP Units	0	0	0	0	0	0	0
Ozone Depletor	GHS H Phrase							
Ozone Depletor	Ozone Classification	Not Classified	Not Classified	Not Classified	Not Classified	Not Classified	Not Classified	Not Classified
Acid Rain Formation	Y/N		N	N	N	N	N	N

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Acid Rain Formation	Key Phrases	Product may	Does not	Does not contain	Does not	Does not	Does not	Does not
		form SO2 or	contain SO2 or	SO2 or NOx	contain SO2	contain SO2 or	contain SO2	contain SO2
		NOx upon	NOx		or NOx	NOx	or NOx	or NOx
		combustion						
NESHAP	Y/N	N	N	N	N	N	N	Υ
NESHAP	Key Phrases	Not listed as	Not listed as	Not listed as EPA	Not listed as	Not listed as	Not listed as	Listed as EPA
		EPA	EPA hazardous	hazardous air	EPA	EPA hazardous	EPA	hazardous air
		hazardous air	air pollutant	pollutant	hazardous air	air pollutant	hazardous air	pollutant
		pollutant			pollutant		pollutant	
PHYSICAL PROPERTIE	:S							
Vapor Pressure	mm Hg				0.08	0		
Flammability: Liquid	NFPA/HMIS	1	1	0	0	0		0
	0,1,2,3,4							
Flammability: Liquid	GHS H Phrase							
Flammability: Liquid	GHS Category	3						
	level							
Flash point: Liquid	deg C	49			110	133		
Flash point: Liquid	Key Phrases	Combustible liquid	Flammable liquid	No Flash point-will not burn				No Flash point-will not burn
Flammability: Gas	GHS H Phrase							
Flammability: Gas	GHS Category Level							
Reactivity	NFPA/HMIS	1	2	0	1	1		3
	0,1,2,3,4							
Reactivity	GHS H Phrase		H201, H202, H250, H251, H261, H270				H204, H205, H290, H252, H272	
Reactivity	GHS Category Level							
рН	pH Units	1-2 or 11.5-14	1-2 or 11.5-14	5-6 or 8-9	1-2 or 11.5-14	2-5 or 9-11.5	6-7 or 7-8	2-5 or 9-11.5
рН	Key Phrases	Highly acidic, highly caustic	Highly acidic, highly caustic	Mildly acidic, mildly alkaline	Acidic, alkaline	Acidic, alkaline	Mildly acidic, mildly alkaline	
Corrosivity	Key Phrases	Highly Coursive	Corrosive	Not corrosive	Not corrosive		mary arkamie	
Corrosivity	GHS Category Level							

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Odor	Key Phrases	Slight odor	Mild odor	Slight odor	Odorless	Pungent or irritating odor		Pungent or irritating odor
Volatile Organic Compound	g/l	0		0				
PROCESS FACTORS			<u>-</u>	<u>-</u>				
Heat	WBGT, deg C							
Noise Generation	dBA/hr			80/no limit				
Vibration	Class 1 Small Machine (mm/s)			1				
Vibration	Class 2 Medium Machine (mm/s)							
Vibration	Class 3 Large Rigid Foundation (mm/s)							
Vibration	Class 4 Large Soft Foundation (mm/s)							
Ergonomic Hazard	Occurence	Unlikely/ remote	Possible	Possible	Unlikely/ remote	Possible	Unlikely/ remote	Possible
Ergonomic Hazard	Hazard Level	Minor injury/illness, minor impact on time lost	Moderate injury, lost time	Minor injury/illness, minor impact on time lost	Minor injury/illness, minor impact on time lost	Minor injury/illness, minor impact on time lost	Minor injury/illness, minor impact on time lost	Minor injury/illness, minor impact on time lost
Psychosocial Hazard	Work Overload and Pace: Work Load						Process improves workload	
Psychosocial Hazard	Work Overload and Pace: Machine Pacing						Adequate machine pacing	

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Psychosocial Hazard	Work Overload and Pace: Time Constraints						Process improves time constraints/ deadlines	
Psychosocial Hazard	Work Schedule: Shift Work						Process normalizes shift work	
Psychosocial Hazard	Work Schedule: Work Isolation	Process requires restricted access	Process requires restricted access	Process eliminates isolation work	Process eliminates isolation work	Process requires restricted access	Process requires restricted access	Process requires restricted access
Psychosocial Hazard	Control	Process provides worker with access to supervisor about needed changes	Process doesn't allow for workers to participate in decision process	Process includes worker input	Process allows for minor changes in real-time by worker	Process allows for minor changes in real-time by worker	Process allows for minor changes in real-time by worker	Process provides worker with access to supervisor about needed changes
Psychosocial Hazard	Work Environment & Equipment: Equipment Stability	J		Improved equipment quality and suitability			Improved equipment quality and suitability	5
Psychosocial Hazard	Work Environment & Equipment: Work Space						Improves work space and surrounding conditions	
High Pressure System	Pressure (Delta % Change From Ambient)	0	0	0	0	0		0
High Temperature System	Temperature (Delta % Change From Ambient)	0	0	0	0	0		0
Water Use	% Water Change							

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Water Use	Reuse							
Energy Use	% Energy Change			25% increase				
Energy Use	% Renewable Energy							
Exposure Potential	Occurence: Near Certain							
Exposure Potential	Occurence: Highly Likely						Minor hazard	
Exposure Potential	Occurence: Likely	Critical hazard	Catastrophic hazard	Minor hazard	Marginal hazard	Marginal hazard		Marginal hazard
Exposure Potential	Occurence: Unlikely							
Exposure Potential	Occurence: Remote						Catastrophic hazard	
LIFE CYCLE FACTORS								
Upstream Effects	Key Phrases	Process reduces suppliers use of hazardous materials, energy, water and other resources	Process requires suppliers to use hazardous materials or excess energy, water, and other resources	Eliminates suppliers use of hazardous materials or reduces use of energy, water, and resources	Eliminates suppliers use of hazardous materials and reduces use of energy, water, and resources	Process reduces suppliers use of hazardous materials, energy, water and other resources	Process reduces suppliers use of hazardous materials, energy, water and other resources	Process reduces suppliers use of hazardous materials, energy, water and other resources
Consumer Hazard	Key Phrases	Product contains hazardous components with low consumer exposure potential	Product contains hazardous components with consumer exposure potential	Product contains hazardous components with no consumer exposure potential	Product contains no hazardous components	Product contains hazardous components with low consumer exposure potential	Product contains hazardous components with no consumer exposure potential	Product contains hazardous components with low consumer exposure potential

Category	Units	Star San	Spartan PAA SANITIZER FP	ECA Device	Lactic acid	Caprylic Acid	NaDCC Tablets	Ozone
Disposal Hazard	Key Phrases	Creates	Creates concern	Prevents/ reduces	Prevents/	Creates	Creates	Creates some
(landfill,		concern for	for air, water or	amount of waste	reduces	concern for air,	concern for	concern for
incineration)		air, water or	land and	material being	amount of	water or land	air, water or	air, water or
		land and	disposed of as	created	waste	and disposed	land and	land
		disposed of as	hazardous		material being	of as	disposed of as	
		hazardous	waste		created	hazardous	hazardous	
		waste				waste	waste	
Reportable Quantity	Pounds							100
Recycling	% Recyclable							
	at End of Life							
Recycling	Uses							
	Products							
	With %							
	Recycled							
	Material							
Renewable to	% Renewable							
Nonrenewable	Materials							
Resource								
Renewable to	Key Words							
Nonrenewable								
Resource								

The P2OASys evaluations were performed using Safety Data Sheets for each product which can be found in Supplement 2. EPA's Estimation Programs Interface, (EPI) Suite™ software was used to assess environmental fate and transport and ecological toxicity data for each product. i

¹ EPI Suite (2020). US EPA Estimation Programs Interface (EPI) Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA.