



VERSION 1.4

JANUARY 2018

GreenScreen[®] for Safer Chemicals

Hazard Assessment Guidance

FOR CHEMICALS, POLYMERS, AND PRODUCTS



GreenScreen[®] Version 1.4

What Changed and Why?

February 28, 2018



Webinar Questions



- Post your question to the Questions Panel in your Control Panel
- Presentation and recording will be available at greenscreenchemicals.org



GreenScreen®



- Transparent method
- Hazard-based
- Comprehensive
- Scientifically robust
- Developed by independent NGO



Purpose

- Provide assessors with technical summary of revisions to GreenScreen methodology focused on polymers and products.



GreenScreen®

Introductory Information

1) [Website](#)

2) [Training](#)

– [Free introductory session](#)

– [Online introductory course](#)

3) [Guidance and Resources](#)



GreenScreen History



- v1.0: Case study; organic chemicals
- v1.1: Inorganic chemicals
- v1.2: Methodology; data gaps
- v1.3: List Translator



Needs Addressed

GreenScreen v1.4 (Jan 2018)

- Polymer hazard assessment
- Assessing products
- Other Refinements
 - GreenScreen Specified Lists
 - GreenScreen List Translator
 - Chemical Hazard Criteria



Speakers



Michelle Turner
*Consulting to
Clean Production Action*



Shari Franjevic
*GreenScreen Program
Clean Production Action*

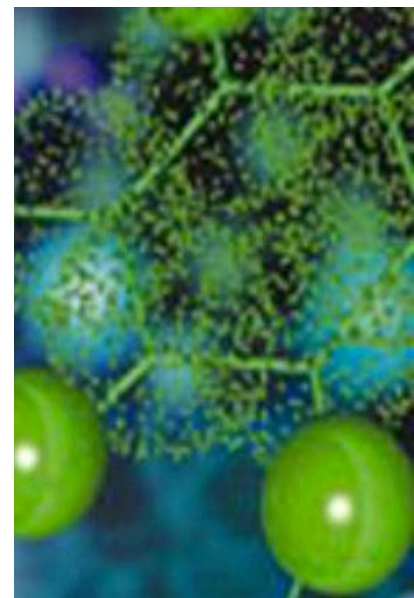


Amy Hunsicker
*Consulting to
Clean Production Action*



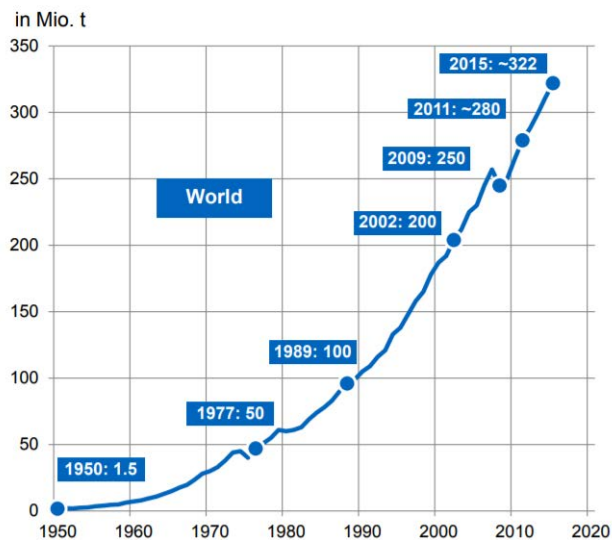
NEW

Polymer Hazard Assessment

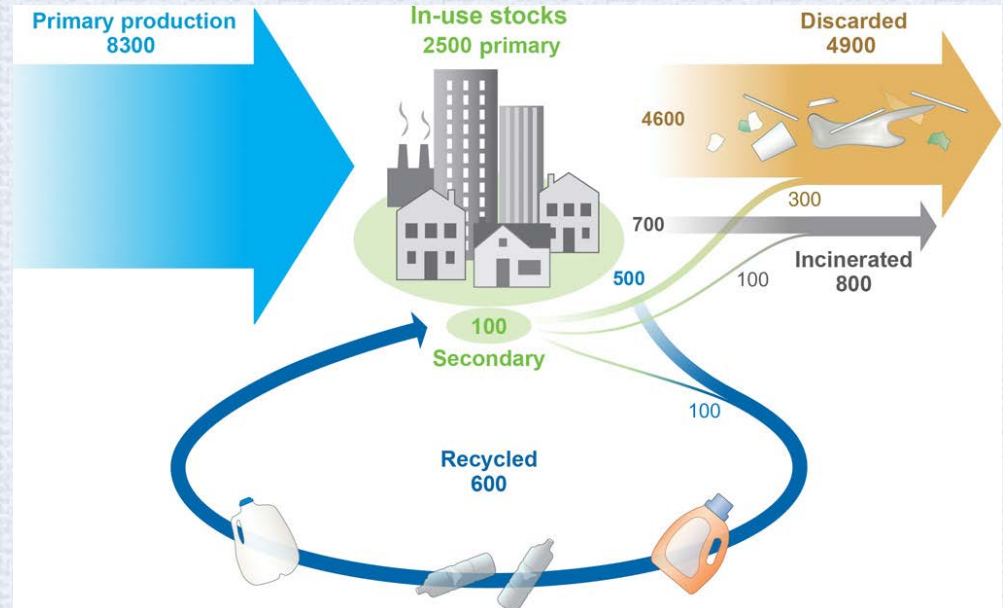


Why Focus on Polymers?

**World
Plastics Production 1950 – 2015**



Includes Thermoplastics, Polyurethanes, Thermosets, Elastomers, Adhesives, Coatings and Sealants and PP-Fibers.
Source: PlasticsEurope Market Research Group (PEMRG) / Consultic Marketing & Industrieberatung GmbH



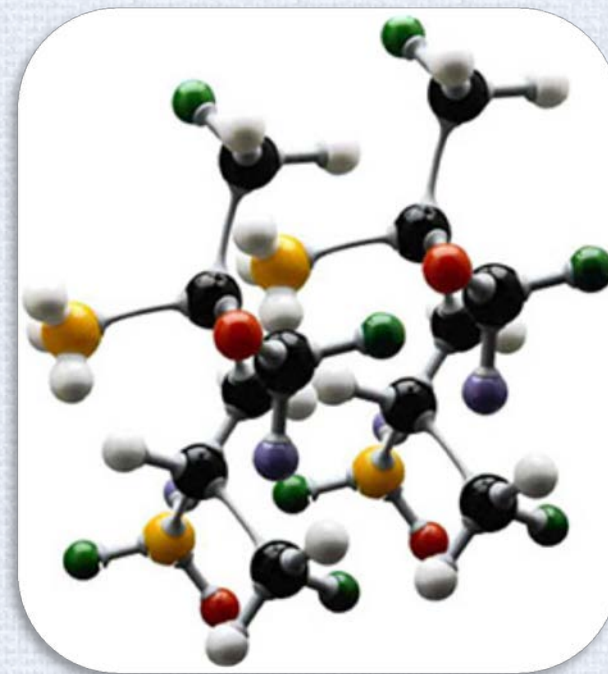
Geyer et al., 2017. *Science Advances* 19 Jul 2017: Vol. 3, no. 7

- Polymers used in some way in all modern technologies
- Transition to circularity requires consideration of toxicity



Assessment Challenges

- Polymers generally considered to have low toxicity
 - Macromolecules too large to be biologically available
- Less requirements under major chemical control laws
 - E.g., EU REACH
- Toxicity data often not available





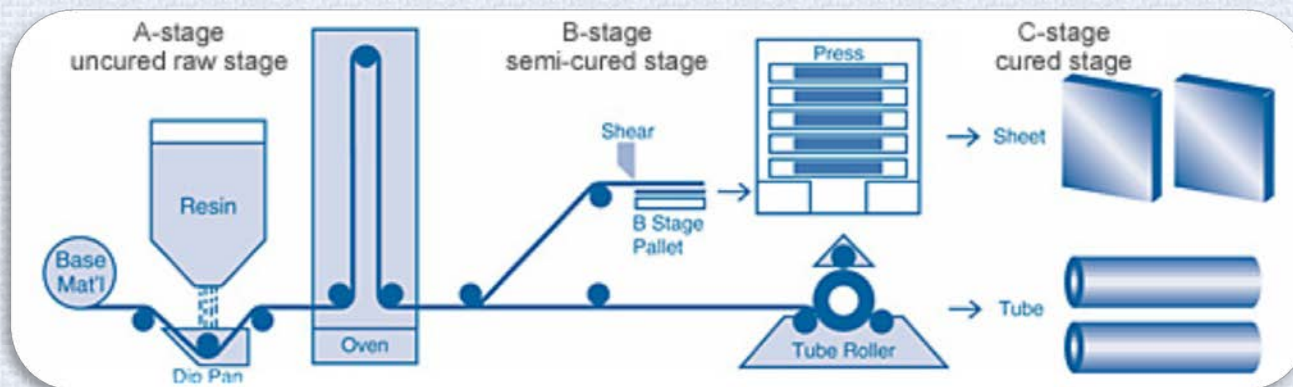
Assessment Challenges

- Polymers are “mixtures” of polymer chains, oligomers, unreacted monomers, catalysts
 - Differences in process chemistry can lead to varying levels of smaller, more bioavailable molecules
 - Can be variability in toxicity across manufacturers for a given CASRN-identified polymer
 - In general, how should unreacted monomer and oligomer hazards be addressed and reported?



Assessment Challenges

- For thermosets, hazards for same CASRN vary as you move through manufacturing chain
 - Placed on the market with relatively high levels of unreacted monomer by intention
 - How to make informed decisions in this case?





GreenScreen v1.3

Focused on Polymeric Material

All constituents intentionally added or impurities ≥ 100 ppm in formula:

Chemical	CAS	% by Weight	Benchmark	Benchmark by %
Polymer	XXX-XX-X	95.0	U	95.0
Functional Additive	XXX-XX-X	0.00001	2	3.0
Processing Aid	XXX-XX-X	1.4	2	
Processing Aid	XXX-XX-X	1.6	2	
Monomer	XXX-XX-X	2.0	1	2.0



Special Case Impurities < 100 ppm in the formula, known to be present:

Chemical	CAS	% by Weight	Score	Reason for inclusion
Monomer 1	XXX-XX-X	0.009% (90 ppm)	LT-1	Monomer
Monomer 2	XXX-XX-X	0.002% (20 ppm)	LT-P1	Monomer
Catalyst A	XXX-XX-X	0.0075% (75 ppm)	LT-1	Catalyst



Reviewed Existing Precedents

- ECHA Guidance for Monomers and Polymers, Guidance for the implementation of REACH
- EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Criteria
- US EPA Polymer Exemption Guidance Manual
- US EPA Safer Choice Standard
- US EPA Interpretive Assistance Document for Assessment of Polymers – Sustainable Futures Summary Assessment
- Globally Harmonized System of Classification and Labelling of Chemicals (GHS)



GreenScreen v1.4 Changes

Defined Two Polymer Types

FIGURE 4. Inventory Constituents of a Polymer Substance

POLYMER SUBSTANCE

- Polymer species of varying lengths
- Residual monomer(s) ≥ 100 ppm
- Oligomers
- Stabilizer(s) ≥ 100 ppm
- Substance impurities ≥ 100 ppm
- Special Case impurities < 100 ppm*

* Special case impurities < 100 ppm (0.01%) are scored and reported separately using the GreenScreen List Translator.

FIGURE 5. Inventory Components of a Polymer Mixture

POLYMER MIXTURE

- Unreacted monomer(s) ≥ 100 ppm

POLYMER SUBSTANCE

- Polymer species of varying lengths
- Oligomers
- Stabilizer(s) ≥ 100 ppm
- Substance impurities ≥ 100 ppm
- Special case impurities < 100 ppm*

* Special case impurities < 100 ppm (0.01%) are scored and reported separately using the GreenScreen List Translator.



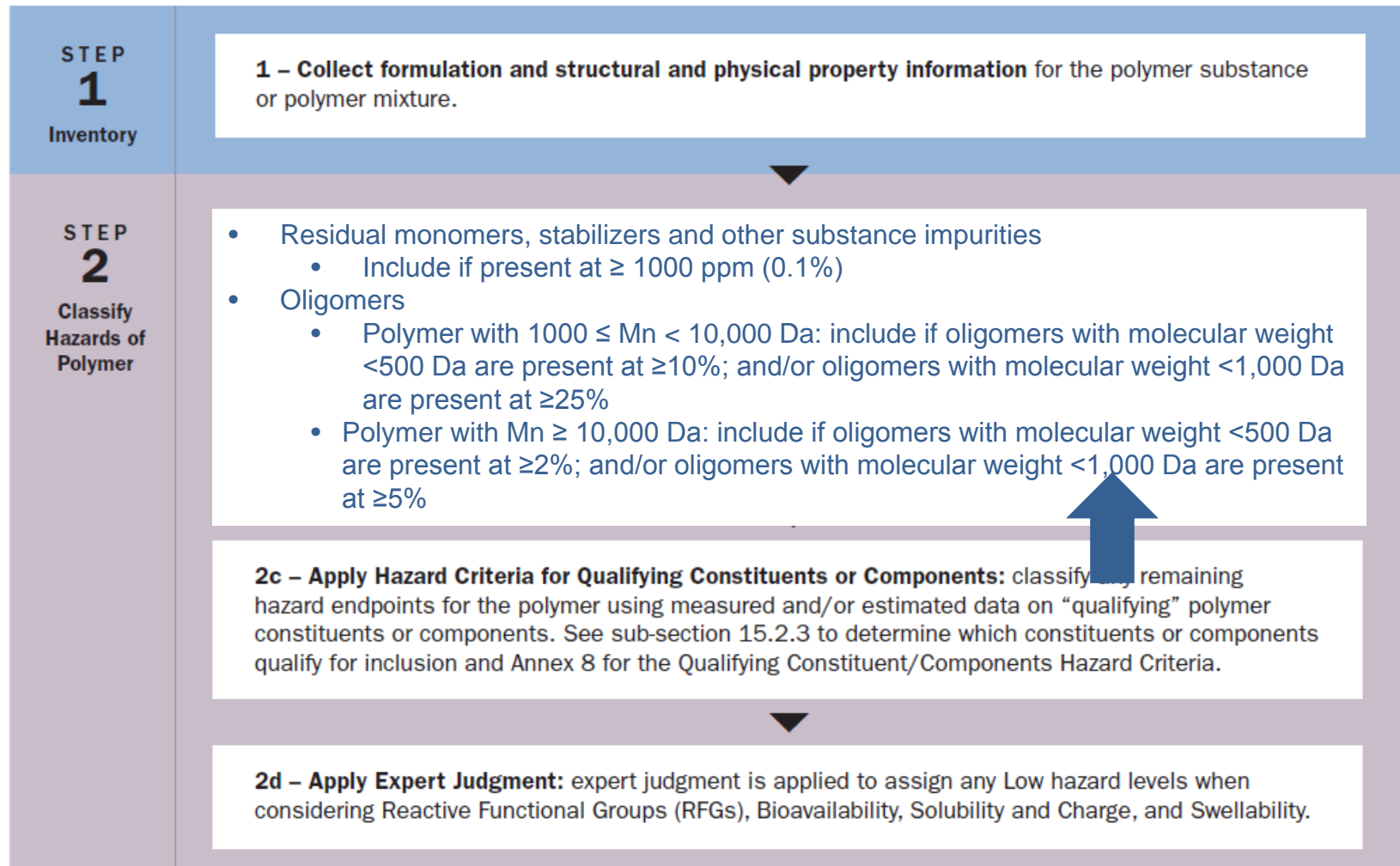
GreenScreen v1.4 Changes

- Defined polymer as a mixture
 - Apply GHS Mixture Rules to fill data gaps
 - Where data are not available on mixture, use information for constituents/components
- Rationale: ECHA Guidance on Polymers and Monomers
 - Classification of polymer for CLP should take into account all constituents, such as unreacted monomers
 - Classification method for polymers should be the same one applied for mixtures



GreenScreen v1.4 Process

FIGURE 3. GreenScreen Polymer Assessment Process





GreenScreen v1.4 Process

STEP 3

Classify
Hazard for
Fate &
Physical
Hazard
Endpoints

3 – Use reliable, measured test data available for the polymer: classify Persistence (P), Bioaccumulation (B), Reactivity (R), and Flammability (F) using the GreenScreen Chemical Hazard Criteria in Annex 1. Expert judgment may be used to predict behavior in the environment based on a given polymer's structure, if experimental, measured data are not available.

STEP 4

Determine
Polymer
Benchmark

- Potential CoHC Step:
 - Based on precautionary principle – important tenet of GreenScreen
 - High hazard residual monomers or catalysts present at 100 ppm or greater

4b – Final Benchmark score:

- Potential Chemicals of High Concern (CoHC)** – For each Group I Human Health endpoint that was classified using Step 2c and assigned a hazard level of moderate, low, or data gap, classify each monomer and/or catalyst present at or above 100 ppm using the GreenScreen Chemical Hazard Criteria in Annex 1. Any High classifications will result in a Benchmark-1_{CoHC} for the polymer.
- Data Gaps** – Determine whether the preliminary Benchmark score assigned in Step 4a should be modified due to failure to meet minimum data requirements following the procedure in Annex 5.
- Environmental Transformation Products (TP)** – Generate a Benchmark or List Translator score for each feasible and relevant environmental transformation product. Scores are used to modify the polymer Benchmark score as described in Section 15.4.2.3.



Example Polymer Assessment v1.3 versus v1.4

Polymer Substance: Alpha

CASRN: 123-45-6

Manufacturer: A&G

Brand: Awesome

No qualifying oligomers

All residual impurities

<100 ppm

Polymer Substance: Alpha

CASRN: 123-45-6

Manufacturer: QuickGo

Brand: Marginal

No qualifying oligomers

Residual monomer

present at 500 ppm



Example Polymer v1.3

Polymer: Alpha

- What should be included in assessment of polymer not clearly defined
- Assessment of polymer does not capture variability in composition of the “mixture” of molecules
- Typically hazard assessment reflected large molecules only but may be unclear
- Frequent data gaps due to lack of data on larger molecules
- Low hazard may be assigned through bioavailability argument without rigorous review of functional groups, etc.
- “Grade A” polymer may receive same score as “Grade B” polymer



Example Polymer v1.3

Polymer: Alpha

CASRN: 123-45-6

Assessment #1

Benchmark score = U

Same score for any grade, manufacturer or composition of small molecules.

GreenScreen Polymer Hazard Summary Table																				
Group I Human					Group II and II* Human								Ecotox		Fate		Physical			
	Carcinogenicity	Genotoxicity/Mutagenicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity	Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability	BM
							single	repeat*												
Polymer	DG	DG	DG	DG	DG	L		DG		DG	L	L	DG	DG	vH	L	DG	L	U	



Example Polymer v1.3

Polymer: Alpha

CASRN: 123-45-6

Assessment #2

Benchmark score = 3

Same score for any grade, manufacturer or composition of small molecules.

GreenScreen Polymer Hazard Summary Table																					
Group I Human					Group II and II* Human								Ecotox		Fate		Physical				
	Carcinogenicity	Genotoxicity/Mutagenicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization *	Respiratory Sensitization *	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability	
							single	repeat*	single	repeat*											*
Polymer	L	L	L	L	DG	L		L		L	L	DG	L	L	L	L	vH	L	L	L	3



Example Polymer Substance v1.4

Polymer Substance: Alpha

- Evaluated as a mixture containing polymer molecules, oligomers, residual monomer, substance impurities (e.g., catalysts)
- Data for qualifying constituents used to classify hazard when data on the polymer substance is not available, thus minimizing data gaps
- Clear guidance and transparent documentation for what data is used to assign hazard score
- High bar and added guidance for assigning low hazard using lack of bioavailability argument
- Differences in polymer substance composition reflected in Benchmark score for polymer substance



Example Polymer Substance v1.4

Polymer Substance: Alpha
 CASRN: 123-45-6
 Manufacturer: A&G
 Brand: Awesome

No qualifying oligomers
 All residual impurities <100 ppm

GreenScreen Polymer Hazard Summary Table																					
Group I Human						Group II and II* Human								Ecotox		Fate		Physical			
Carcinogenicity	Genotoxicity/Mutagenicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability		
						single	repeat*	single	repeat*	*	*										BM
Polymer Substance	L	L	L	L	DG	L		L		L	L	DG	L	L	L	L	vH	L	L	L	3



Example Polymer Substance v1.4

Polymer Substance: Alpha
 CASRN: 123-45-6
 Manufacturer: QuickGo
 Brand: Marginal

No qualifying oligomers
 Residual monomer at 500 ppm

GreenScreen Polymer Hazard Summary Table																					
Group I Human					Group II and II* Human								Ecotox		Fate		Physical				
	Carcinogenicity	Genotoxicity/Mutagenicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability	
							single	repeat*	single	repeat*											*
Polymer Substance	DG	M	L	L	DG	L	M	M		L	L	DG	H	H	M	M	vH	L	L	L	1 _{CoHC}
Residual Monomer at 500 ppm	H				M																

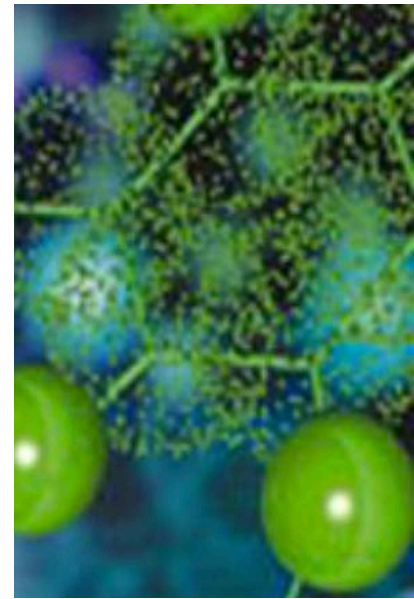
Hypothetical example for illustration purposes





NEW

Assessing Products





Method Improvements

v1.3

- Did not define product types
- Lacked detailed guidance
- No assessment template for products

v1.4

- Product types are defined
- Clearly outlines disclosure thresholds
- Product assessment template is provided



Assessing Products

GreenScreen v1.4

- Continued emphasis on transparency:
 - A product assessed using GreenScreen does not receive a single Benchmark score.
 - Each constituent or component present in a product above the thresholds specified in this section is assessed and receives a Benchmark score.
- Product claims are handled under the GreenScreen Certified™ process



Product Claims

GreenScreen Certified™

- Currently available product standards:
 - GreenScreen Certified™ Standard for Textile Chemicals
 - Expanding to additional product categories
 - Contact CPA directly related to specific desired claims





Product Types

Non-polymeric product types:

1. Chemical substance – contains two or more chemical compounds
2. Chemical mixture – contains two or more chemical substances

Polymeric product: Polymeric material

- Polymeric material – contains a polymer and functional additives
- Examples of polymeric materials include compounded plastics, adhesives, foams, and resins

Variable product types contain one or more non-polymeric or polymeric components:

1. Homogeneous material
2. Article



Non-Polymeric Products

Chemical Mixture

Chemical Substance #1

Chemical
Compound #1



Chemical
Compound #2



...



...

Chemical Substance #2

Chemical
Compound #3



Chemical
Compound #4



...



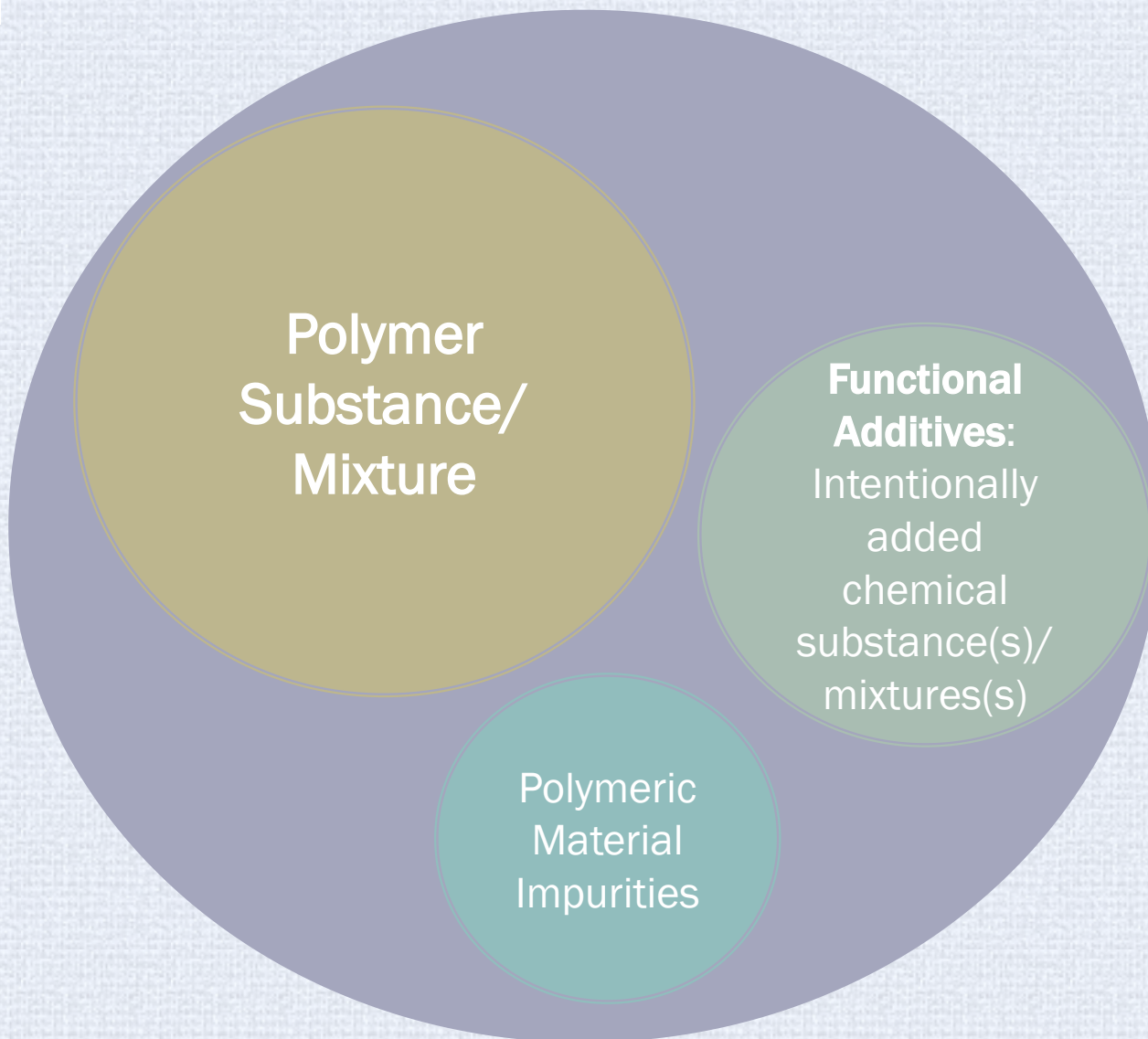
Assessment Thresholds

Non-Polymeric Products

Type of Chemical Compound	Disclosure Threshold	Assessment Requirement
INTENTIONALLY ADDED	> 0 ppm (0%) in the product	GreenScreen Benchmark score according to Section I
IMPURITIES (Unintentional)	> 100 ppm (0.01%) in the product	GreenScreen Benchmark score according to Section I
IMPURITIES or SPECIAL CASE IMPURITIES (Unintentional)	< 100 ppm (0.01%) in the product	GreenScreen List Translator score according to Section IV



Polymeric Materials





Assessment Thresholds

Polymeric Materials

Type of Component	Disclosure Threshold	Assessment Requirement
Polymer Substance or Polymer Mixture	> 0 ppm (0%) in the polymeric material	GreenScreen Benchmark score according to Section II
Chemical substances or mixtures (Intentional; Functional Additives)	> 0 ppm (0%) in the polymeric material	GreenScreen Benchmark score as a Non-Polymeric Product
MATERIAL IMPURITIES (Unintentional)	> 100 ppm (0.01%) in the polymeric material	GreenScreen Benchmark score according to Section I
MATERIAL IMPURITIES or SPECIAL CASE IMPURITIES (Unintentional)	< 100 ppm (0.01%) in the polymeric material	GreenScreen List Translator score according to Section IV



Section VI – Assessment Templates

The following assessment templates can be downloaded in the Microsoft Word format at:
<https://www.greenscreenchemicals.org/method/method-documents>

TEMPLATE 1

GreenScreen Chemical Assessment Report Template

TEMPLATE 2

GreenScreen Polymer Substance Assessment Report Template

TEMPLATE 3

GreenScreen Polymer Mixture Assessment Report Template

TEMPLATE 4

GreenScreen Product Assessment Report Template

GREENSCREEN BENCHMARK™ SUMMARY

This product assessment report includes a GreenScreen Benchmark™ score and attached individual assessment reports for the product inventory listed in Table 1 and any impurities in Table 2 below.

The product itself has not been assigned a single Benchmark score. No product claims can be made without licensing through Clean Production Action.

Product claims are handled via GreenScreen Certified™

Table 1. Product Benchmark Summary

Product Component(s)	Chemical Name	Trade Name or CASRN	% by weight in product	Benchmark Score	Assessment Report Number
Polymer Mixture	Various	EZ-Clean Paint, #EZ-50-BLK	85	1	GSA-23
Solvent	Chemical A	42123-45-8	1	2	GSA-43
Pigment	Chemical B	6472-81-2	8	3	GSA-876
	Chemical C	2976-34-2	6	4	GSA-88

Each assessment is attached separately to the final report

Table 2. Impurities < 100 ppm: Special Case and Known

Chemical Name	CASRN	(ppm)	GreenScreen List Translator score	Function	Reason for Inclusion
Impurity 1	135-49-2	50	LT-UNK	Impurity	Special Case Impurity

Table 3. Weight Percentage of Product at Each Benchmark Score

1	2	3	4
85%	1%	8%	6%



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Polymers Technical Peer Review Group



New Courses in 2018!

- 1) [DESIGNING A CHEMICALS MANAGEMENT POLICY](#): How to write or update a comprehensive chemicals and materials management policy that goes beyond regulatory compliance
- 2) [FACING THE CHAOS OF CHEMICAL LISTS](#): How to effectively use chemical lists to proactively avoid known chemicals of high concern to human health or the environment
- 3) [MEASURING AND REDUCING CHEMICAL FOOTPRINTS](#): How to measure current chemical footprint and progress to sustainability goals, based on case studies from leading practitioners
- 4) [AVOIDING REGRETTABLE SUBSTITUTES WITH GREENSCREEN®](#): How to identify safer alternatives to chemicals of concern with GreenScreen® for Safer Chemicals



Thank You!

Questions?

Presentation and recording to be posted
at: greenscreenchemicals.org

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