

**GreenScreen® Assessment for [Resorcinol Bis-Diphenylphosphate (CAS#125997-21-9)]**

**Method Version: GreenScreen® Version 1.2<sup>1</sup>**

**Verified or Non-Verified<sup>2</sup>: NON-VERIFIED**

**Introduction<sup>3,4,5</sup>**

This GreenScreen assessment is based on the information reported in the corresponding chemical hazard profile in “An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE) Final Report”<sup>3</sup>. Additional information on hazard endpoints beyond what was included in the final report was not sought with the exception of reactivity. Hazard classification information for reactivity was supplemented because it is not included in the DfE report but is needed to apply the GreenScreen Benchmark system.

Hazard classification levels reported in the DfE profiles and in this GreenScreen report may differ due to differences between criteria as defined in the DfE “Alternatives Assessment Criteria for Hazard Evaluation”<sup>4</sup> and the GreenScreen for Safer Chemicals v1.2 methods<sup>5</sup>. Any differences in interpretation are explained and justified in this GreenScreen report.

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Date: February 9, 2014 (expires after 3 years)	Date: March 19, 2014
Licensed Profiler or Certified Practitioner (specify): N/A	

**Confirm application of the *Disclosure and Assessment Rules and Best Practice*<sup>6</sup>:** (List any deviations)

Disclosure thresholds applied by DfE are unclear in the DfE report.

<sup>1</sup> Use GreenScreen® Assessment Procedure (Guidance) V1.2

<sup>2</sup> “NON-VERIFIED” means that Verification Has Not Been Performed on this GreenScreen Assessment

<sup>3</sup> An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE) Final Report <http://www.epa.gov/dfe/pubs/projects/decaBDE/deca-report-complete.pdf> p 4-588

<sup>4</sup> Available at: [http://www.epa.gov/dfe/alternatives\\_assessment\\_criteria\\_for\\_hazard\\_eval.pdf](http://www.epa.gov/dfe/alternatives_assessment_criteria_for_hazard_eval.pdf), accessed 10/2013.

<sup>5</sup> Details available at: <http://www.cleanproduction.org/Greenscreen.v1-2.php>, accessed 10/2013.

<sup>6</sup> See GreenScreen Guidance V1.2 Section 8

**Chemical Name (CAS #):**

Resorcinol Bis-Diphenylphosphate (CAS# 125997-21-9)

**Also Called:**

Phosphoric trichloride, polymer with 1,3-benzenediol, phenyl ester (TSCA Inventory); Resorcinol bis (biphenyl phosphate); Phosphoric acid, 1,3-phenylene tetraphenyl ester; Phosphorous oxychloride, reaction product with resorcinol and phenol; Resorcinol bis-diphenylphosphate; Tetraphenyl resorcinol diphosphate

**Tradenames:**

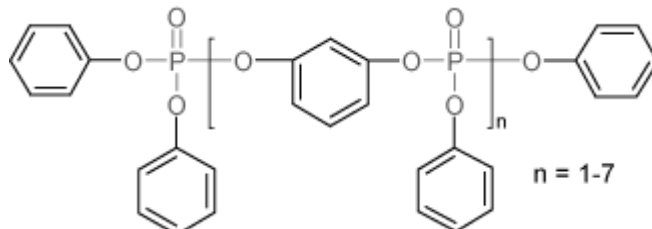
Fyrolflex RDP; Plamtar-RDP; RBBPP; Reofos RDP

**Suitable analogs or moieties of chemicals used in this assessment (CAS #'s):**

Aryl phosphates and other confidential analogs

**Chemical Structure(s):**

\*Note: Include chemical structure(s) of all suitable analogs (and /or moieties) used in the assessment.



**Notes related to production specific attributes<sup>7</sup>:**

**For Inorganic Chemicals and relevant particulate organics (if not relevant, list NA)**

**Define Properties:**

1. Particle size (e.g., silica of respirable size)
2. Structure (e.g., amorphous vs. crystalline)
3. Mobility (e.g., water solubility, volatility)
4. Bioavailability: Poor absorption is predicted for low MW fractions for all routes of exposure.

**For Polymeric Materials: (delete this section if not a polymeric material)**

**Identify Monomers and Corresponding Properties**

According to the DfE report, "This alternative is a polymer; the n=1 and n=2 oligomers are those with a MW <1,000. EPI v4.0 was used to estimate physical/chemical and environmental fate values due to an absence of experimental data. The higher MW oligomers are anticipated to behave similar to the oligomer where n=2.

The material used by industry for flame retardant applications is most likely the polymeric material with CAS number 125997-21-9, although the CAS number for the discrete organic where n=1,

<sup>7</sup> Note any composition or hazard attributes of the chemical product relevant to how it is manufactured. For example, certain synthetic pathways or processes result in typical contaminants, by-products or transformation products. Explain any differences between the manufactured chemical product and the GreenScreen assessment of the generic chemical by CAS #.

57583-54-7 (Phosphoric acid, P,P'-1,3-phenylene P,P',P'-tetraphenyl ester), has been used interchangeably with 125997-21-9 in the publicly available literature.”<sup>8</sup>

Details for the following section were not available in DfE report.

1. % of Each Monomer
  - a) Monomer 1
  - b) Monomer 2
  - c) Monomer 3
2. Are the monomers blocked? (Y/N)
3. Molecular Weight (MW) of polymeric material
4. % of polymeric material with
  - a) MW <500
  - b) MW <1,000
5. % Weight Residual Monomers
6. Solubility/Dispersability/Swellability
7. Particle size
8. Overall charge of polymeric material
9. Identify constituents and residual concentrations of
  - a) Catalysts
  - b) Processing aids
10. Identify any monomers, oligomers, catalysts or processing aids classified as Benchmark 1 according to the hazard identification lists in the GreenScreen List Translator.

**Identify Applications/Functional Uses:**  
**(e.g., Cleaning product, TV casing)**

1. Flame Retardant

**GreenScreen Benchmark Score and Hazard Summary Table:**<sup>9,10,11,12</sup>

Resorcinol Bis-Diphenylphosphate was assigned a **Benchmark Score of 2** based on very high ecotoxicity; moderate Group I human toxicity endpoints (carcinogenicity); and high bioaccumulation and moderate toxicity.

Resorcinol Bis-Diphenylphosphate could be a Benchmark 1 if the data gap for endocrine activity or respiratory sensitization was filled with data indicating a high hazard score. Resorcinol Bis-Diphenylphosphate could be a Benchmark 1<sub>TP</sub> if any of the transformation products were determined to be Benchmark 1 and feasible and relevant.

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<sup>8</sup> An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE) Final Report <http://www.epa.gov/dfe/pubs/projects/decaBDE/deca-report-complete.pdf> p 4-588

<sup>9</sup> See Appendix A for a glossary of hazard endpoint acronyms

<sup>10</sup> See Appendix B for alternative GreenScreen Hazard Summary Table (Classification presented by exposure route)

<sup>11</sup> For inorganic chemicals only, see GreenScreen Guidance V1.2 Section 14.4. (Exceptions for Persistence)

<sup>12</sup> For Systemic Toxicity and Neurotoxicity, repeated exposure data are preferred. Lack of single exposure data is not a Data Gap when repeated exposure data are available. In that case, lack of single exposure data may be represented as NA instead of DG. See GreenScreen Guidance V1.2 Section 9.3.

Group I Human					Group II and II* Human								Ecotox		Fate		Physical		
C	M	R	D	E	AT	ST		N	SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F	
						single	repeated	single	repeated										
<i>M</i>	<i>L</i>	<i>L</i>	<i>M</i>	DG	<i>L</i>		<i>M</i>		<i>M</i>	<i>L</i>	DG	<i>L</i>	<i>M</i>	<i>vH</i>	<i>vH</i>	<i>M</i>	<i>H</i>	<i>L</i>	<i>L</i>

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II\* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M and L) instead of three (i.e., H, M and L), and are based on single exposures instead of repeated exposures.

### Environmental Transformation Products and Ratings<sup>13</sup>:

**Identify feasible and relevant environmental transformation products (i.e., dissociation products, transformation products, valence states) and/or moieties of concern<sup>14</sup>**

**According to the DfE report:** Environmental degradation of RDP has been demonstrated in experimental studies (IUCLID, 2001); however the degradates have not been identified. Degradation of RDP by sequential dephosphorylation could produce phenol (CASRN 108-95-2), diphenyl phosphate (CASRN 838-85-7), or resorcinol (CASRN 108-46-3). The importance of dephosphorylation relative to possible competing pathways has not been demonstrated in a published study.

Functional Use	Life Cycle Stage	Transformation Pathway	Environmental Transformation Products	CAS #	Feasible and Relevant?	GS List Translator Score or GS Benchmark Score
			Phenol	108-95-2		LT-P1 (Pharos)
			Resorcinol	108-46-3		LT-P1 (Pharos)
			Diphenyl phosphate	838-85-7		LT-U GreenWERC S

### Introduction

The material used by industry for flame retardant applications is most likely the polymeric material with CAS number 125997-21-9, although the CAS number for the discrete organic where n=1, 57583-54-7 (Phosphoric acid, P,P'-1,3-phenylene P,P',P'-tetraphenyl ester (TSCA Inventory) has been used interchangeably with 125997-21-9 in the publicly available literature.

<sup>13</sup> See GreenScreen Guidance V1.2 Section 13

<sup>14</sup> A moiety is a discrete chemical entity that is a constituent part or component of a substance. A moiety of concern is often the parent substance itself for organic compounds. For inorganic compounds, the moiety of concern is typically a dissociated component of the substance or a transformation product.

## **Hazard Classification Summary Section:**

### **For all hazard endpoints:**

- **Search all GreenScreen specified lists. Report relevant results either in each hazard endpoint section or attach to the end of the report.**
- **Always indicate if suitable analogs or models were used.**
- **Attach modeling results (See Appendix C).**
- **Include all references either in each hazard endpoint section or at the end of the report.**

### **Group I Human Health Effects (Group I Human)**

#### **Carcinogenicity (C) Score (H, M or L): *M***

Resorcinol Bis-Diphenylphosphate was assigned a score of MODERATE for Carcinogenicity based on a moderate score and data provided within the EPA's DfE alternatives assessment. The moderate designation in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on professional judgment based on analogy to aryl phosphates and is therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:  
MODERATE: Estimated to have uncertain potential for carcinogenicity based on analogy to aryl phosphate analogs and professional judgment.

#### **Mutagenicity/Genotoxicity (M) Score (H, M or L): *L***

Resorcinol bis-diphenylphosphate was assigned a score of LOW for Mutagenicity based on a low score within the EPA's DfE alternatives assessment. The low designation in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on *in vitro* and *in vivo* test data for RDP within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:  
LOW: Resorcinol bis-diphenylphosphate did not cause gene mutations or chromosomal aberrations *in vitro* and did not produce an increase in micronuclei in mice *in vivo*.

#### **Reproductive Toxicity (R) Score (H, M, or L): *L***

Resorcinol bis-diphenylphosphate was assigned a score of LOW for Reproductive Toxicity based on a low score within the EPA's DfE alternatives assessment. For reproductive toxicity, EPA's DfE uses numerical data quantifying the hazard associated with the 3 different hazard levels, whereas Green-Screen does not base the hazard score on a numerical rating system but bases classifications on listing under GHS, the EU and NTP. Therefore the conversion of DfE's developmental and reproductive toxicity conclusions to comparable GreenScreen hazard scores is done on a case by case basis. DfE's low score was based on no clinical signs of toxicity observed in a two generation dietary reproduction study in rats. While there was one study included within EPAs alternatives assessment which indicated reproductive toxicity for a confidential analog the low hazard score is based on reproductive toxicity test on RDP. The score was based on test data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:

LOW: Experimental data for resorcinol bis-diphenylphosphate indicate no adverse effects on reproductive performance or fertility parameters at doses up to 1,000 mg/kg-day (highest dose tested) in a two generation dietary study in rats. There may be potential for reproductive toxicity based on analogy to confidential analog.

**Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M or L): M**

Resorcinol bis-diphenylphosphate was assigned a score of MODERATE for Developmental Toxicity based on a moderate score within the EPA's DfE alternatives assessment. For developmental toxicity, EPA's DfE uses numerical data quantifying the hazard associated with the 3 different hazard levels, whereas GreenScreen does not base the hazard score on a numerical rating system but bases classifications on listing under GHS, the EU, and NTP. Therefore the conversion of DfE's developmental and reproductive toxicity conclusions to comparable GreenScreen hazard scores is done on a case by case basis. DfE's moderate score was based on test data using RDP and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

MODERATE: Based on a NOAEL of 50 mg/kg bw-day in a two generation dietary reproduction study in rats. Adverse effects included delayed vaginal opening and preputial separation at a dose of 500 mg/kg bw-day. No adverse developmental effects were observed in rabbits following oral administration of resorcinol bis-diphenylphosphate at doses up to 1000 mg/kg bw-day.

**Endocrine Activity (E) Score (H, M or L): DG**

Resorcinol bis-diphenylphosphate was assigned a score of DATA GAP for Endocrine Activity based on no data locates.

The summary provided within the EPA's alternatives assessment was as follows:

No data located.

**Group II and II\* Human Health Effects (Group II and II\* Human)**

*Note: Group II and Group II\* endpoints are distinguished in the v 1.2 Benchmark system (the asterisk indicates repeated exposure). For Systemic Toxicity and Neurotoxicity, Group II and II\* are considered sub-endpoints. When classifying hazard for Systemic Toxicity/Organ Effects and Neurotoxicity endpoints, repeated exposure results are required and preferred. Lacking repeated exposure results in a data gap. Lacking single exposure data does not result in a data gap when repeated exposure data are present (shade out the cell in the hazard table and make a note). If data are available for both single and repeated exposures, then the more conservative value is used.*

**Acute Mammalian Toxicity (AT) Group II Score (vH, H, M or L): L**

Resorcinol bis-diphenylphosphate was assigned a score of LOW for Acute Mammalian Toxicity. The acute mammalian toxicity classification in both the EPA's DfE and GreenScreen assessments is based on the same measured endpoints. While the EPA's alternatives assessment discusses uncertainty with an inhalation study results indicated no effects at the highest concentration tested. The acute mammalian toxicity score was based on test data and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

LOW: Based on an oral LD<sub>50</sub> >5,000 mg/kg-bw and a dermal LD<sub>50</sub> >2,000 mg/kg-bw in rats. The acute inhalation study in rats produced no deaths at the highest dose tested. The LC<sub>50</sub> of >4.14 mg/L could not be used to evaluate the hazard designation because it is uncertain at which dose the LC<sub>50</sub>

would occur; the criteria threshold for LOW is 5 mg/L for mists. Though unlikely, it is uncertain if the LC<sub>50</sub> could occur between 4.15 mg/L and 5.0 mg/L (a MODERATE hazard designation).

**Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)**

**(ST-single) Group II Score (single dose: vH, H, M or L):**

DfE evaluates Systemic Toxicity based on repeated exposures. Lack of data for Systemic Toxicity based on a single exposure does not constitute a data gap when data for repeated exposures are available.

**(ST-repeat) Group II\* Score (repeated dose: H, M, L): M**

Resorcinol bis-diphenylphosphate was assigned a score of MODERATE for Systemic Toxicity/Organ Effects based on repeated exposure. The moderate designation for systemic toxicity/organ effects on repeated exposure in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on inhalation test data within EPA's alternatives assessment which was adjusted to correspond to a 90-day chronic evaluation and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

MODERATE: Experimental data for resorcinol bis-diphenylphosphate reported alveolar histiocytosis in rats following a 4-week inhalation exposure to 0.5 mg/L aerosol (NOAEL = 0.1 mg/L). The criteria threshold for a low hazard designation is 0.2 mg/L for mists based on 90-day repeated dose studies; guidance values are tripled for 28-day study evaluations making the MODERATE hazard range from 0.06 – 0.6 mg/L. No other exposure-related gross or microscopic pathology was identified in any organ. There is also potential for liver toxicity based on a confidential analog, though no effects occurred at 300 mg/kg/day for that analog (higher than the criteria threshold for a low hazard designation).

In addition:

Resorcinol bis-diphenylphosphate had no effect on immunological parameters at doses up to 5,000 mg/kg-day (highest dose tested) in an oral gavage study in mice.

**Neurotoxicity (N)**

**(N-single) Group II Score (single dose: vH, H, M or L):**

DfE evaluates Neurotoxicity based on repeated exposures. Lack of data for Neurotoxicity based on a single exposure does not constitute a data gap when data for repeated exposures are available.

**(N-repeat) Group II\* Score (repeated dose: H, M, L): M**

Resorcinol bis-diphenylphosphate was assigned a score of MODERATE for Neurotoxicity based on a moderate score within the EPA's DfE alternatives assessment. This conclusion within the DfE report was based on adjustment of a 28-day inhalation LOAEL of 0.5 mg/L. The moderate designation in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on experimental data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

MODERATE: Based on a 28-day inhalation LOAEL of 0.5 mg/L for inhibition of plasma ChE in rats (NOAEL = 0.1 mg/L); criteria values are tripled for chemicals evaluated in 28-day studies; the LOAEL of 0.5 mg/kg-day falls within the Moderate hazard criteria (0.06 - 0.6 mg/L).

**Skin Sensitization (SnS) Group II\* Score (H, M or L): *L***

Resorcinol bis-diphenylphosphate was assigned a score of LOW for Skin Sensitization. This conclusion was based on expert judgment with no additional information provided. The low designation for skin sensitization in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on expert judgment within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

LOW: Estimated to not have potential for skin sensitization based on expert judgment.

**Respiratory Sensitization (SnR) Group II\* Score (H, M or L): DG**

Resorcinol bis-diphenylphosphate was assigned a score of DATA GAP for Respiratory Sensitization. This conclusion was based on no data located.

**Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M or L): *L***

Resorcinol bis-diphenylphosphate was assigned a score of LOW for Skin Irritation/Corrosivity based on tests results provided within the EPA's DfE alternatives assessment which indicates resorcinol bis-diphenylphosphate is not irritating in rabbit skin tests. DfE categorizes resorcinol bis-diphenylphosphate as a very low dermal irritant which corresponds to a low score under GreenScreen Skin Irritation/Corrosivity. The score was based on test data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:

VERY LOW: Resorcinol bis-diphenylphosphate was not a dermal irritant in rabbits.

**Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M or L): *M***

Resorcinol bis-diphenylphosphate was assigned a score of MODERATE for Eye Irritation based on tests results provided within the EPA's DfE alternatives assessment which indicates resorcinol bis-diphenylphosphate is a slight eye irritant in rabbits. DfE categorizes resorcinol bis-diphenylphosphate as a low eye irritant which corresponds to a moderate score under GreenScreen Eye Irritation/Corrosivity. The score was based on test data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

LOW: Resorcinol bis-diphenylphosphate produced mild irritation in rabbit eyes; however, clearing occurred within 24 hours.

**Ecotoxicity (Ecotox)**

**Acute Aquatic Toxicity (AA) Score (vH, H, M or L): *vH***

Resorcinol bis-diphenylphosphate was assigned a score of VERY HIGH for Acute Aquatic Toxicity. The very high designation for acute aquatic toxicity in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on values from experimental data reported for daphnia exposures to resorcinol bis-diphenylphosphate. The score was based on test data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:



VERY HIGH: Based on measured EC<sub>50</sub> values for daphnia. Measured values for fish and algae are higher than the water solubility limit, suggesting no effects at saturation (NES).

#### **Chronic Aquatic Toxicity (CA) Score (vH, H, M or L): vH**

Resorcinol bis-diphenylphosphate was assigned a score of VERY HIGH for Chronic Aquatic Toxicity. The very high designation for chronic aquatic toxicity in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on 21-day NOEC=0.021 mg/L in *Daphnia magna*. The score was based on experimental data and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

VERY HIGH: Based on an experimental 21-day NOEC=0.021 mg/L in *Daphnia magna*. Estimated ChV values suggest a High hazard with the n =1 oligomer (phosphate esters ECOSAR class) of 0.0093 mg/L for fish..

#### **Environmental Fate (Fate)**

##### **Persistence (P) Score (vH, H, M, L, or vL): M**

Resorcinol bis-diphenylphosphate was assigned a score of MODERATE for Persistence. The score was based on measured degradation following Directive 84/449/EEC which found after 56 days, 66% biodegradation occurred. The hazard score is based on measured values within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:

MODERATE: Moderate persistence is expected for resorcinol bis-diphenylphosphate based on experimental biodegradation studies that indicate the potential for biodegradation of the commercial polymeric mixture. The commercial mixture was determined to be inherently biodegradable using the guidelines of Directive 84/449/EEC, C.6 "Biotic degradation - the Closed Bottle test" test. After 28 days, 37% biodegradation occurred and after 56 days, 66% biodegradation occurred. Resorcinol bis-diphenylphosphate oligomers (n=1 and n=2) do not contain chromophores that absorb at wavelengths >290 nm, and therefore, are not expected to be susceptible to direct photolysis by sunlight. The atmospheric half-life of resorcinol bis-diphenylphosphate oligomers are estimated to be 6.1 (n=1) and 4.1 (n=2) hours, although they are expected to exist primarily in the particulate phase in air. Additionally, resorcinol bis-diphenylphosphate is estimated to undergo hydrolysis slowly under neutral and acidic conditions.

##### **Bioaccumulation (B) Score (vH, H, M, L, or vL): H**

Resorcinol bis-diphenylphosphate was assigned a score of HIGH for Bioaccumulation. The high designation for bioaccumulation in EPA's alternatives assessment is equivalent to a high score in GreenScreen. The score was based on an estimated measured BCF value and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

HIGH: The estimated BCF value for the n=1 component has high potential for bioaccumulation. The higher MW oligomers that may be found in this mixture (n=2, 3, 4...) are expected to have moderate or low potential for bioaccumulation based on their large size and low solubility according to the Sustainable Futures (SF) polymer assessment guidance (U.S. EPA, 2010).

#### **Physical Hazards (Physical)**

**Reactivity (Rx) Score (vH, H, M or L): L**

Resorcinol bis-diphenyl phosphate was assigned a score of LOW for Reactivity based on professional judgment and structural similarity to other chemicals with supporting information from industry. Because of the lack of concrete data for this endpoint, the score of LOW was italicized.

Resorcinol bis-diphenyl phosphate is very similar to phosphate containing flame retardants such as triphenyl phosphate (TPP) and resorcinol diphenyl phosphate (RDP), which is currently used extensively in consumer products and has been found not to be reactive. TPP (CAS 115-86-6) and RDP (125997-21-9) will be used as a surrogates for this flame retardant.

TPP has been assigned a NFPA hazard Classification of '0' for instability which indicates '... materials that are normally stable, even under fire exposure conditions, and that do not react with water.' (HSDB, 2013) The State of New Jersey has also identified TPP as having a NFPA ranking of '0' for reactivity (New Jersey, 2003). This ranking is reinforced by industry, which has assigned TPP an NFPA reactivity hazard of '0' (Sigma-Aldrich, 2013).

A Material Safety Data Sheet (MSDS) from ICL Industrial Products identified that RDP had an NFPA and HMIS rates of '0' for reactivity. Another MSDS from Chemtura identified that Resorcinol bis-diphenylphosphate is '*Stable under normal conditions of handling and use.*'

A Material Safety Data Sheet (MSDS) from ICL Industrial Products identified that Resorcinol bis-diphenylphosphate had an NFPA and HMIS rates of '0' for reactivity. Another MSDS from Chemtura identified that Resorcinol bis-diphenylphosphate is '*Stable under normal conditions of handling and use.*'

Based upon professional judgment and information supplied by industry, resorcinol bis-diphenylphosphate is unlikely to be reactive.

**References:**

National Library of Medicine's Hazardous Substances Database, data on [triphenyl phosphate](#), accessed 12/2013.

New Jersey Department of Health and Senior Services, Hazard Substances Fact Sheet, [Triphenyl Phosphate](#), May 2000, 6 p., accessed 12/2013.

Sigma-Aldrich, Material Safety Datasheet for [Triphenyl phosphate](#), 7 p., accessed 12/2013.

ICL Industrial Products Material Safety Data Sheet for Fyrolflex RDP, revised 02/05/2011, available at: <http://doc.ccc-group.com/msds/english/457061.pdf>, accessed 12/2013.

Chemtura Material Safety Data Sheet for Reofos RDP, 2/06/2006, 7 pages, available at: <http://wenku.baidu.com/view/d7ed6b114431b90d6c85c7fd.html>, accessed 12/2013.

**Flammability (F) Score (vH, H, M or L): L**

Resorcinol bis-diphenylphosphate was assigned a score of LOW for Flammability based on a not flammable description within the DfE report. This conclusion was based on adequate data and is not reported in italics.

**APPENDIX A: Hazard Benchmark Acronyms  
(alphabetical order)**

- (AA) Acute Aquatic Toxicity**
- (AT) Acute Mammalian Toxicity**
- (B) Bioaccumulation**
- (C) Carcinogenicity**
- (CA) Chronic Aquatic Toxicity**
- (Cr) Corrosion/ Irritation (Skin/ Eye)**
- (D) Developmental Toxicity**
- (E) Endocrine Activity**
- (F) Flammability**
- (IrE) Eye Irritation/Corrosivity**
- (IrS) Skin Irritation/Corrosivity**
- (M) Mutagenicity and Genotoxicity**
- (N) Neurotoxicity**
- (P) Persistence**
- (R) Reproductive Toxicity**
- (Rx) Reactivity**
- (SnS) Sensitization- Skin**
- (SnR) Sensitization- Respiratory**
- (ST) Systemic/Organ Toxicity**