GreenScreen™ Assessment for
Isopropylated triphenyl phosphate (IPTPP) (CAS# 68937-41-7)

Method Version: GreenScreen™ Version 1.2[1]

GreenScreen (GS) Assessment Type[2]: CERTIFIED

Introduction[3,4,5]

This GreenScreen assessment, for all hazard endpoints (except reactivity), is based solely on the information reported in the corresponding chemical hazard profile in "An Alternatives Assessment for Flame Retardants Used in Flexible Polyurethane Foam[3].

Additional information on hazard endpoints (other than reactivity) beyond what was reported in the draft June 2014 report was not sought. It was necessary to supplement the hazard classification for reactivity as it is not included in the DfE approach but is needed in order to apply the GreenScreen Benchmarks.

Differences in hazard classification levels reported in the DfE profiles and in this GreenScreen report may be due to differences between criteria as defined in the DfE "Alternatives Assessment Criteria for Hazard Evaluation"[4] and the GreenScreen for Safer Chemicals v1.2 methods[5]. Any differences in interpretation are explained and justified in this GreenScreen report.

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Licensed Profiler or Certified Practitioner (specify): N/A	Licensed Profiler or Certified Practitioner (specify): N/A

Confirm application of the *Disclosure and Assessment Rules and Best Practice*[6]: (List any deviations)
Disclosure thresholds applied by DfE are unclear in the DfE report.

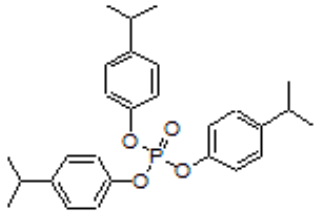
[1] Use GreenScreen™ Assessment Procedure (Guidance) V1.2
[2] Available at: http://www.greenscreenchemicals.org/about/greenscreen-terms-of-use
[3] Available at: http://www.epa.gov/dfe/pubs/projects/flameret/ffr-update-complete.pdf, accessed 11/2014.
[4] Available at: http://www.epa.gov/dfe/alternatives_assessment_criteria_for_hazard_eval.pdf, accessed 10/2013.
[5] Details available at: http://www.cleanproduction.org/Greenscreen.v1-2.php, accessed 10/2013.
[6] See GreenScreen Guidance V1.2 Section 8

Chemical Name (CAS #):
Isopropylated triphenyl phosphate (IPTPP) (CAS# 68937-41-7)

Also Called:
Phenol, isopropylated, phosphate (3:1); IPPP; ITP; IPTPP; TIPPP; Isopropylated triphenyl phosphate; Isopropylated phenol phosphate

Suitable analogs or moieties of chemicals used in this assessment (CAS #'s):
Tris(isopropylphenyl) phosphate isomers and other isopropyl substituted phenyl phosphate esters anticipated to be present in the commercial product were considered in the evaluation, as indicated in the chemical considerations section; orthocresyl phosphate

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



Representative Structure

Notes related to production specific attributes[7]:

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

1. Particle size (e.g., silica of respirable size): NA
2. Structure (e.g., amorphous vs. crystalline): NA
3. Mobility (e.g., water solubility, volatility): NA
4. Bioavailability: No data were available on the absorption, distribution or metabolism of isopropylated triphenyl phosphates in experimental animals or humans. Dermal absorption rates in human epidermis studies for IPTPP component TPP were 0.67 and 0.9 μg/cm2/h for Reolube HYD 46 and Reofos 50, respectively. Absorption rates for IPTPP component 2-IDPP were 0.54 and 3.32 μg/cm2/h, for Reolube HYD 46 and Reofos 50, respectively. Steady state was achieved within one hour. Experimental data for the FM550 (a mixture made up of a sum total of TBB and TBPH of 50% with other components identified as IPTPP and TPP) indicate that absorption of TBB can occur in rats following oral exposure from gestation through lactation.

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

1. Flame Retardant

[7] 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 #.

GreenScreen Benchmark™ Score and Hazard Summary Table:[8,9,10,11]

Isopropylated triphenyl phosphate (IPTPP) (CAS# 68937-41-7) was assigned a **GS Benchmark Score of 2** based on very high ecotoxicity, high Group II human toxicity (repeat dose systemic), and high bioaccumulative in addition to moderate human toxicity. In a worst case scenario if the data gaps were filled with high hazard scores Isopropylated triphenyl phosphate (IPTPP) would continue be a benchmark 2.

Green Screen Hazard Ratings: Isopropylated triphenyl phosphate																			
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*										
M	*L*	**M**	**M**	*M*	**L**	NA	*H*	*H*	*M*	*L*	DG	*L*	*M*	*vH*	*vH*	*M*	*H*	*L*	*L*

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. NA reflects that there was not data for this endpoint in the DfE assessment; however, it is not considered a data gap if the DfE report assesses repeated dose data for the same endpoint.

[8] See Appendix A for a glossary of hazard endpoint acronyms
[9] See Appendix B for alternative GreenScreen Hazard Summary Table (Classification presented by exposure route)
[10] For inorganic chemicals only, see GreenScreen Guidance V1.2 Section 14.4. (Exceptions for Persistence)
[11] 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.

Environmental Transformation Products and Ratings[12]: Identify feasible and relevant environmental transformation products (i.e., dissociation products, transformation products, valence states) and/or moieties of concern[13]

Functional Use	Life Cycle Stage	Transformation Pathway	Environmental Transformation Products	CAS #	Feasible and Relevant?	GS List Translator or Benchmark Score
			Phenol	108-95-2		**LT-P1**
			isopropylphenol	25168-06-3		**ND**
			diphenyl phosphate	838-85-7		**ND**
			2-isopropyl phenol	88-69-7		**ND**
			4-isopropyl phenol	99-89-8		**ND**
			3-isopropylphenol	618-45-1		**ND**
			diisopropyl phenols and corresponding mono and diphenyl phosphates by hydrolysis	27923-56-4		**NF**

ND = No data found in a GreenScreen ListTranslator NF = CAS number not found in Green Screen ListTranslator

[12] See GreenScreen Guidance V1.2 Section 13

[13] 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.

Introduction

An Environmental Risk Evaluation report for isopropylated triphenyl phosphate was published in August 2009. This substance is part of EPA‟s HPV Challenge and is a registered substance with the European Chemicals Agency (Great Lakes Chemical Corporation, 2001; Environment Agency, 2009; ECHA, 2013a, 2013b).

Triphenyl phosphate, may contain a mixture consisting of isopropylated triphenyl phosphates, with an unspecified amount of isopropylation. Mono- to nona-isopropylphenyl phosphate have been found, for example tris[2,4,6-tri(propan-2-yl)phenyl] phosphate. The majority of isomers contain isopropyl substitution at the ortho- and para- position although meta isomers may be present to a lesser extent. The isopropyl groups are typically distributed between the three phenyl rings; however, di- and tri- alkylation may be present on a single phenyl ring (for example, diisopropylphenyl diphenyl phosphate (CASRN 58570-87-9)). Isomers expected to be present will be discussed in this report as appropriate when determining hazard designations. A description of the test sample and isomer content is included in the data entries when available. However test substance composition was not consistently reported in the literature. Chemical, fate, and toxicity data for components of the mixture represented by other CASRN were collected in the preparation of this AA and are listed below:

- Phenol, isopropylated, phosphate (3:1) (CASRN 68937-41-7)
- Triphenyl phosphate, TPP (CASRN 115-86-6)
- 4-isopropylphenyl diphenyl phosphate (CASRN 55864-04-5)
- 2-isopropylphenyl diphenyl phosphate (CASRN 64532-94-1)
- Isopropyl phenyl diphenyl phosphate (CASRN 28108-99-8); (CASRN 101299-37-0)
- 2-(1-Methylethyl)phenyldiphenyl ester phosphoric acid mixture w/triphenyl phosphate (CASRN 96300-97-9); (CASRN 66797-44-2)
- Di(isopropylphenyl)phenylphosphate (CASRN 28109-00-4)
- Di(2-isopropylphenyl)phenylphosphate (CASRN 69500-29-4)
- Tri(3-isopropylphenyl)phosphate (CASRN 72668-27-0)
- Tri(isopropylphenyl)phosphate (CASRN 26967-76-0)
- Tri(4-isopropylphenyl)phosphate (CASRN 2502-15-0)
- 3,4-bis(1-methylethyl)phenyl diphenyl ester (CASRN 68155-51-1)

Estimated values using representative structures as indicated in the SMILES section of this assessment will be used to fill assessment data gaps. EPI v4.11 was used to estimate physical/chemical and environmental fate values due to an absence of experimental data (Weil, 2001; ECHA, 2013b).

Hazard Classification Summary Section:

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M or L): *M*
Isopropylated triphenyl phosphate was assigned a score of MODERATE for carcinogenicity based on a moderate score within the EPA's DfE Alternatives Assessment. The EPA's classification is based upon OncoLogic program estimates of marginal risk for carcinogenicity. The moderate carcinogenic designation in the EPA's Alternatives Assessment is equivalent to a moderate designation within the GreenScreen. The score was the obtained via modeling software and is therefore reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
MODERATE: No adequate carcinogenicity studies were located. The OncoLogic program estimates marginal risk for carcinogenicity; In addition, there is uncertainty regarding the carcinogenicity of Isopropylated triphenyl phosphate due to the lack of data for this substance. Carcinogenic effects cannot be completely ruled out.

Mutagenicity/Genotoxicity (M) Score (H, M or L): *L*
Isopropylated triphenyl phosphate was assigned a score of LOW for mutagenicity based on a low score within the EPA's DfE Alternatives Assessment. The EPA's classification is based on a weight of evidence approach in evaluating studies primarily with negative results. The low designation for mutagenicity in both GreenScreen and EPA's Alternatives Assessment is based on the same criteria. Due to the uncertainty in the chemical composition used in the studies the hazard score is of lower confidence and is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment is as follows:
LOW: Based on weight of evidence that includes negative results in gene mutation tests (in vitro and in vivo) and no evidence of chromosomal aberrations (in vivo) in mice. One chromosomal aberration test in hamsters resulted in positive results; however, based on weight of evidence, it seems the potential for genotoxicity is Low. All studies were conducted using commercial mixtures of Reofos 50 and/or Reolube HYD 46 (composition not specified).

Reproductive Toxicity (R) Score (H, M, or L): M
Isopropylated triphenyl phosphate was assigned a score of MODERATE for reproductive toxicity based on data provided within the EPA's DfE Alternatives Assessment. This is different from the HIGH level of concern identified in the DfE Alternatives Assessment. The EPA's classification is based on changes in ovarian and epididymal weights (25 and 100 mg/kg-day, respectively) and reduced fertility. For reproductive 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 reproductive toxicity conclusion to comparable GreenScreen hazard scores is done on a case by case basis. The final study results which serve as the basis of the EPA's score for reproductive toxicity study were not available for DfE review. In addition the formulation of the test substance was not specified it has therefore been concluded that the quality of data is not sufficient to place the substance in a GHS Category 1. Therefore the IPTPP has been scored as a GHS Category 2 for reproductive toxicity. In addition the risk phrase R62 corresponds to a moderate classification within the GreenScreen. The score was based upon study data included

within the EPA's Alternatives Assessment and therefore is bolded within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was summarized as follows:
HIGH: Based on a LOAEL of 25 mg/kg-day in a combined subchronic reproductive/developmental toxicity screening test in rats. Effects included changes in ovarian and epididymal weights (25 and 100 mg/kg-day, respectively) and reduced fertility (100 and 400 mg/kg-day); the final study results were not available and the formulation of the test substance was not specified. In addition, this substance has been assigned the risk phrase R62 - possible risk of impaired fertility. In a dermal study with Reolube HYD (components not specified) in rats, reduced absolute and relative testicular weights and slight testicular tubular atrophy were observed at 1,000 mg/kg-day.

Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M or L): M
Isopropylated triphenyl phosphate was assigned a score of MODERATE for developmental toxicity based on data provided within the EPA's DfE Alternatives Assessment. This is different from the HIGH level of concern identified in the DfE Alternatives Assessment. The EPA's classification is based on numerous changes in developmental outcome post exposure. 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 toxicity conclusion to comparable GreenScreen hazard scores is done on a case by case basis The final study results which serve as the basis of the EPA's score for developmental toxicity were not available for DfE review. In addition the formulation of the test substance was not specified. It has therefore been concluded that the quality of data is not sufficient to place the substance in a GHS Category 1. Therefore the IPTPP has been scored as a GHS Category 2 for developmental toxicity. In addition the risk phrase R63 corresponds to a moderate classification within the GreenScreen. The score was based upon study data included within the EPA's Alternatives Assessment and therefore is bolded within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
HIGH: Estimated based on analogy to Kronitex TCP (1330-78-5). Reduced fetal body weight was reported at 20 mg/kg-day (NOAEL not established; lowest dose tested) in a developmental study in rats orally exposed to the analog. In addition, increased skeletal variations were reported at 750 mg/kg-day for the analog. A LOAEL of 400 mg/kg-day (NOAEL = 100 mg/kg-day) was reported following exposure to Isopropylated triphenyl phosphate in a combined subchronic reproductive/developmental toxicity screening test in rats. Effects included reduced pre- and post-natal survival; the final study results were not available and the formulation of the test substance was not specified. Development effects were reported in a study in pregnant Wistar rats administered a FM550 mixture (sum total of TBB and TBPH approximately 50% with additional components identified as IPTPP and TPP) during gestation though lactation (GD8 - PND21); developmental effects included early female puberty, weight gain, altered exploratory behavior, and increased male left ventricle thickness (LOAEL = 1 mg/kg-day, NOAEL = 0.1 mg/kg-day). It is uncertain which component or components of the FM 550 mixture is driving the reported developmental effects. This substance has been assigned the risk phrase R63 - possible risk of harm to the unborn child. There were no experimental data for the neurodevelopmental toxicity endpoint located; There is uncertain concern for developmental neurotoxicity based on the potential for Cholinesterase (ChE) inhibition in dams that may result in alterations of fetal neurodevelopment.

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

The DfE Alternative Assessment does not assign a hazard score for endocrine activity but provides information relevant to this endpoint. Using EPA provided data isopropylated triphenyl phosphate was assigned a score of MODERATE for endocrine activity based on evidence of endocrine activity without clear evidence of related human health effects. The score was based on study data within the EPA's Alternatives Assessment which used commercial mixtures of IPTPP and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
No data were available for this test substance. Effects to the adrenal glands were reported following dermal application of the commercial mixture Kronitex 50 to shaved rat skin. Changes to adrenal weights and testicular weights were also reported following exposure to a commercial mixture of Kronitex 50 (Components not specified); these changes may be indicative of endocrine activity. Increased serum thyroxine (T4) levels were reported in the serum of dams following oral administration to the analog FM550 (mixture of 50% sum total of TBB and TBPH and additional components identified as IPTPP and TPP). It is unclear which component or components of the mixture are driving the endocrine activity effects.

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

Isopropylated triphenyl phosphate was assigned a score of LOW for acute mammalian toxicity based on a low score within the EPA's DfE Alternatives Assessment. Acute mammalian toxicity classification in both the EPA's DfE and GreenScreen are based on the same criteria. The acute mammalian toxicity score was based on test data and therefore is bolded within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
LOW: Based on the weight of evidence for multiple studies. The test substance was not acutely toxic to rats, rabbits, and Chinese hamsters via the oral route and rats and rabbits via the dermal route of exposure. Acute inhalation data were inadequate to assess hazard. Oral and dermal LD_{50} values ranged from >2,000 to >20,000 mg/kg. Adequate data for the inhalation route were not located.

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. This endpoint was not assessed by DfE in this evaluation and is assigned an 'NA'.

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

Isopropylated triphenyl phosphate was assigned a score of HIGH for repeated exposure systemic toxicity/organ effects based on data within the EPA's DfE report. The high designation for repeated exposure systemic toxicity/organ effects in both GreenScreen and EPA's Alternatives Assessment are based on the same criteria. The high hazard score is based on a LOAEL of 25 mg/kg-day determined for changes in organ weight during a 28-day exposure period. Following GreenScreen guidance, this value is adjusted to a 90-day exposure period (28/90) x 25 mg/kg-day corresponding to a 90-day adjusted LOAEL of 7.8 mg/kg-day. The score was based on study data in which the final study results were not available and the test substance formulation was not specified. Therefore is the high score is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
HIGH: Based on a combined repeated dose with reproductive/developmental toxicity screen test in rats; a LOAEL of 25 mg/kg-day (lowest dose tested) was determined for changes in organ weights (NOAEL was not established); final study results were not available and the test substance formulation was not specified. A LOAEL of 460 mg/kg-day in rats following 28 days of dietary exposure to commercial mixture Kronitex- 100 (composition not specified). Dermal NOAELs were 100 and 200 mg/kg-day in rats following 4 weeks of exposure to commercial mixtures Kronitex 50 and Reolube HYD, respectively. In addition, there may be some potential for repeated dose effects based on analogy to TPP, a component of the commercial mixture.

In addition for immunotoxicity:

No data located.

Neurotoxicity (N)
(N-single) Group II Score (single dose: vH, H, M or L): *H*
Isopropylated triphenyl phosphate was assigned a score of HIGH for single dose neurotoxicity based on a high score within the EPA's DfE Alternatives Assessment. While DfE does not score separately for single and repeat dosing, information provided within the Alternatives Assessment report allowed for a single dose score to be developed. The HIGH GreenScreen score is based on significant inhibition of brain ChE and NTE activity observed in rats following single oral gavage with 2,000 mg/kg of commercial mixture Reofos 54 and ataxia and degenerative neurological effects following single 8-hour exposure to aerosols of Reofos 50 at 2.4 mg/L. The score was based on study data using a commercial mixture within EPA's Alternatives Assessment and therefore is reported in italics within the GreenScreen assessment.

(N-repeat) Group II* Score (repeated dose: H, M, L): *M*
Isopropylated triphenyl phosphate was assigned a score of MODERATE for repeat dose neurotoxicity based on a data provided within the EPA's DfE Alternatives Assessment. Specifically data provided within the DfE report indicate that ataxia and axonal degeneration could be elicited by repeated dosing at 90 mg/kg-day or higher. This concentration is associated with a moderate hazard score within the GreenScreen criteria. The study used a commercial mixture within EPA's Alternatives Assessment. As a mixture is not identical to the pure compound, the result is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
HIGH: Based on analogy to ortho-cresyl phosphate; IPTPP has the potential to undergo a similar mechanism of action as ortho-cresyl phosphate with the formation of an intermolecular intermediate

that effects the nervous system. Significant inhibition of brain ChE and NTE activity was observed in rats following single oral gavage with 2,000 mg/kg of commercial mixture Reofos 54. Inhibition of ChE was also seen in rats following dermal exposure with 500 and 1,000 mg/kg of commercial mixtures Kronitex 50 and Reolube HYD, respectively. There is potential for neurotoxicity based on a structural alert for organophosphates.

Skin Sensitization (SnS) Group II* Score (H, M or L): *L*
Isopropylated triphenyl phosphate was assigned a score of LOW for skin sensitization based on a low score within the EPA's DfE Alternatives Assessment. The low designation for skin sensitization in both GreenScreen and EPA's Alternatives Assessment are based on the same criteria. This conclusion was made based on study details using commercial mixture and reported in a secondary source and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
LOW: The commercial mixtures Reofos 50 and Reolube HYD 46 were not sensitizing to guinea pigs

Respiratory Sensitization (SnR) Group II* Score (H, M or L): DG
Isopropylated triphenyl phosphate was assigned a score of DATA GAP for respiratory sensitization. This conclusion was made based on no data located.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M or L): *L*
Isopropylated triphenyl phosphate was assigned a score of LOW for Skin Irritation/Corrosivity based on a data provided within the EPA's DfE Alternatives Assessment. While the DfE's low dermal irritant score corresponds to a moderate score under GreenScreen Skin Irritation/Corrosivity, there is no indication within the Alternatives Assessment report that any irritation was observed after exposures. Therefore, a low score has been assigned. This score is based on a study using commercial mixtures. As a commercial mixture is not identical to the pure compound, the result is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
LOW: Based on no evidence of irritation in rabbit skin. Two of the studies were conducted using mixtures of isopropylated triaryl phosphates and triphenyl phosphate with undefined chemical compositions. The data may not be suitable to determine the potential for skin irritancy.

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M or L): *M*
Isopropylated triphenyl phosphate was assigned a score of MODERATE based on a low score within the EPA's DfE Alternatives Assessment. The DfE score is based on slight ocular irritation that cleared within 10 days post instillation. The DfE low hazard score for eye irritation corresponds to a moderate score under GreenScreen Eye Irritation/Corrosivity. The score was based on test data within EPA's Alternatives Assessment using a commercial mixture and not pure IPTPP and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
LOW: Based on no irritation to slight ocular irritation that cleared within 10 days post instillation.

Ecotoxicity (Ecotox)

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

Isopropylated triphenyl phosphate was assigned a score of VERY HIGH for acute aquatic toxicity based on a very high score within the EPA's DfE Alternatives Assessment. The very high designation for acute aquatic toxicity in both GreenScreen and EPA's Alternatives Assessment are based on the same criteria. The score was based on study data using a commercial mixture and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
VERY HIGH: Based on experimental LC_{50} values of <0.3 mg/L in fish (conducted using commercial mixture Phosflex [28-30% triphenyl phosphate, along with isomers of isopropylphenyl diphenyl phosphate, isomers of diisopropylphenyl diphenyl phosphate and tri-substituted phenol phosphates]) and 0.25 mg/L in daphnia (conducted using isopropyl phenyl diphenyl phosphate [composition not specified]). The reported water solubility values from studies on commercial mixtures may not adequately represent all components of the mixture. The tris(isopropylphenyl) phosphate isomers and other isopropyl substituted phenyl phosphate ester components anticipated to be present in the commercial product are expected to have a range of water solubility values. Therefore NES may be predicted for some components but not others. Estimated data using the ECOSAR program predicted no effects at saturation (NES) for these organisms. Two experimental studies were available for green algae which determined a 14-day NOEC and LOEC of 0.1 mg/L for Kronitex 200 and Phosflex 31P (major components triphenyl phosphate and 2-isopropylphenyl diphenyl phosphate), respectively. Estimated data based on the monoisopropyl diphenyl phosphate predict Very High hazard for algae; however, estimated data using other isomers predicted no effects at saturation (NES). In addition, this substance has been assigned the risk phrase R50/R53 - Very toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

Chronic Aquatic Toxicity (CA) Score (vH, H, M or L): *vH*
Isopropylated triphenyl phosphate was assigned a score of VERY HIGH for chronic aquatic toxicity based on a very high score within the EPA's DfE Alternatives Assessment. The very high designation for chronic aquatic toxicity in both GreenScreen and EPA's Alternatives Assessment is based on the same criteria. The score was based on study data using a commercial mixture. As a commercial mixture is not the same as the pure compound, the result is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
VERY HIGH: Based on experimental LOECs < 0.1 mg/L in fish and daphnia using commercial mixtures Kronitex 200 and Phosflex 31. The reported water solubility values from studies on commercial mixtures may not adequately represent all components of the mixture. The tris(isopropylphenyl) phosphate isomers and other isopropyl substituted phenyl phosphate ester components anticipated to be present in the commercial product are expected to have a range of water solubility values. Therefore NES may be predicted for some components but not others. No chronic experimental data were available for algae. Estimated data using the ECOSAR program and monoisopropyl class predict very high hazard for fish, daphnia and algae; however, estimated data using other isomers predict no effects at saturation (NES) for all organisms. In addition, this substance has been assigned the risk phrase R50/R53 - Very toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

Environmental Fate (Fate)

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

Isopropylated triphenyl phosphate was assigned a score of MODERATE for persistence based on data and a moderate persistence score within the DfE report. The score was based on evidence of IPTPP biodegradation in soils of 16<60 days and a biodegradation in water of 16<40 days corresponding to a moderate hazard score. The score was based on study data using a commercial mixture and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was summarized as follows:
MODERATE: The environmental half-life of the isopropylated triphenyl phosphate is expected to be >16 days based on experiments using commercial mixtures of this alternative. Commercial isopropylated triphenyl phosphate mixtures passed some ready biodegradable tests, but not all (17.9% degradation in 28 days using a closed bottle test, OECD 301D). Substantial degradation seen over extended time periods indicates that the substance can be considered to be inherently biodegradable. Ultimate degradation is expected based on studies with mixed microbial populations from sludge acclimated to the test substance in a semi-continuous activated sludge system (SCAS), a modified Sturm method experiment and a die-away test. Some degradation under anaerobic conditions of the triaryl phosphate isomers mixture is also expected based on an anaerobic sediment study. The isopropylated triphenyl phosphate mixture components will undergo hydrolysis under alkaline conditions, with estimated hydrolysis half-lives of <13 days at pH 9. The mixture is expected to be relatively stable to hydrolysis under neutral and acidic conditions, with estimated half-lives of >2 years at pH 7. Isopropylated triphenyl phosphate mixture components are not expected to be susceptible to direct photolysis by sunlight, since they do not absorb light at wavelengths >290 nm. The atmospheric half-live of vapor-phase isopropylated triphenyl phosphate mixture components is estimated to be <12 hours.

Bioaccumulation (B) Score (vH, H, M, L, or vL): *H*
Isopropylated triphenyl phosphate was assigned a score of HIGH for bioaccumulation based on a high score within the EPA's DfE Alternatives Assessment. The high designation for bioaccumulation in EPA's Alternatives Assessment is equivalent to a high score in GreenScreen. The hazard score is based on a BAF of 1,300-1,900 for Trixylenyl phosphate; 400 for Tricresyl phosphate. Based on whole fish wet-weight, equilibrium in the fish was not reached for these compounds (Estimated by analogy). The score is based on study data using commercial mixtures and anologs and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's Alternatives Assessment was as follows:
HIGH: The bioaccumulation designation is based on the estimated BAF values for the isopropylated triphenyl phosphate compounds; these values are >1,000. Measured BCF of <9,250, are available for a commercial mixture containing isopropylated triphenyl phosphate. However, there is lower confidence in the experimental BCF values because they are not consistent with the limited water solubility of this chemical, and because the studies were performed on a mixture of unquantified components. Toxicokinetic and fish metabolism studies determined that in some species, isopropylated phenyl phosphate is likely to be bioavailable and undergo metabolism and elimination. Additional, lower BCF values were reported from studies with the isomer isopropylphenyl diphenyl phosphate that would result in a Moderate designation. The BAF was used preferentially as the removal rate of isopropylated triphenyl phosphates in some species of fish may not compete with the rate of uptake.

Physical Hazards (Physical)

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

Isopropylated triphenyl phosphate was assigned a score of LOW for reactivity based upon data found in Material Safety Data Sheets and expert judgment related to its structure and chemical composition. DfE does not assess reactivity and this data is added to the information found in the DfE Alternatives Assessment. As this conclusion was based on limited documentation and expert judgment, it is reported in italics.

Flammability (F) Score (vH, H, M or L): *L*
Isopropylated triphenyl phosphate was assigned a score of LOW for flammability based its use as a flame retardant . This conclusion was based on expert judgment and is reported in italics.

Reactivity References:

ICL Industrial Products Material Safety Data Sheet (MSDS), Phosflex 41L, propylated triphenyl phosphate, Material Number 57023145, Revision 2, published 11/22/2010, 8 pages, Section 2. Hazards identification, NFPA and HMIS Ratings, '*Reactivity = 0*' for both, Section 10. '*Stability: Stable under normal conditions*', accessed 11/16/2014.

Expert judgment:
Isopropylated triphenyl phosphate is a substituted form of TPP or triphenyl phosphate. The US National Institute of Health's Hazardous Substances Database indicates that TPP is not reactive, specifically '*Instability: 0. This degree includes materials that are normally stable, even under fire exposure conditions, and that do not react with water. Normal fire fighting procedures may be used.*' The addition of three propyl groups to the TPP structure would further decrease the instability or reactivity of the resultant compound. For these reasons, isopropylated triphenyl phosphate is expected to be non-reactive based upon professional judgment.

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

Appendix B
Optional Exposure Stratified GreenScreen Hazard Summary Table

Exposure Route	GreenScreen Hazard Ratings: [*Chemical Name*]																			
	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	repeate	single	repeated‡										
oral																				
dermal																				
inhalation																				

Appendix C
Modeling Results

Attach:

- **EPISuite Results for Chemical Name (CAS #)**
- **ECOSAR Results for Chemical Name (CAS #)**
- **Other**