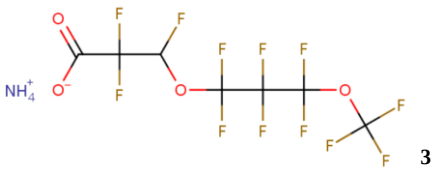
Updated EHS Summary of ADONA for the MA TURA Science Advisory Board Meeting – September 18, 2019

CAS # [1] 958445-44-8 1280222-90-3[2]  3	**NAME[4]** 2,2,3-Trifluoro-3-[1,1,2,2,3,3-hexafluoro-3-(trifluoromethoxy)propoxy] propanoate, ammonium salt **Synonyms[5]:** ADONA; Ammonium 4,8-dioxa-3 H-perfluorononanoate; Propanoic acid, 2,2,3-trifluoro-3-[1,1,2,2,3,3-hexafluoro-3-(trifluoromethoxy) propoxy], ammonium salt; 3H-Perfluoro-3-[(3-methoxy-propoxy) propanoic acid] ammonium salt; **RTECS #:** No data available **EINECS #[6]:** 480-310-4 **Molecular Formula[7]:** $C_7H_5F_{12}NO_4$ **Molecular weight[8]**: 395.1g/mol **Related Substances[9]:** anion: 4,8-Dioxa-3H-perfluorononanoic acid or DONA (919005-14-4); Methyl ester: Propanoic acid, 2,2,3-trifluoro-3-[1,1,2,2,3,3-hexafluoro-3-(trifluoromethoxy)propoxy] methyl ester or MeDONA (958445-54-0); 958445-54-0;[10]
PHYSICAL CHARACTERISTICS	
Primary Use	Used as emulsifier in the production of various fluoropolymers, polymer production aid (PPA) and as a coating agent for industrial and domestic use.[11]
Physical state, odor at room temperature & pressure	Solid at 20 °C, white to off-white crystalline solid (Gordon, et al., 2011).[12] ADONA is manufactured or used as a 10-50% solution in water. ADONA is an ammonium salt of a highly fluorinated oxoacid. The molecule dissociates to ammonium and DONA anion in aquatic solution.[13]
Melting point; Boiling point	MP: 164°C ; BP**:** 183°C[14] MP: -12 to -5°C ; BP**:** 100-105°C at 1013 hPa (30% solution in water)[15] MP: 38°C ; BP: 100-105°C (Gordon, et al., 2011)[16]
Solubility	Water solubility >5.45e-4 mol/L[17]
Specific Gravity	1.16 g/ml (30% aqueous solution) (Gordon, et al., 2011)[18]
SAFETY/PHYSICAL HAZARDS	
Vapor Pressure	2.83e-2 mm Hg[19]
Flammability	No data available
Flashpoint	No flash-point up to the boiling temperature was determined for ADONA (30% solution in water) (EU Method A.9)[20]

Flammability Rating	No data available
Auto Ignition Point	No data available
Combustion products	No data available
Explosivity (UEL, LEL, shock sensitive)	Not Explosive
Oxidizer	No data available
Corrosivity	pKa is less than 3 (Gordon, et al., 2011)[21]
pH	6.5 ± 1.0 (30% aqueous solution) (Gordon, et al., 2011) [22]
Reactivity	Non- Reactive (Gordon, et al., 2011)[23]
Viscosity	2.605 mPa·s at 25˚C (25% aqueous solution)[24]
Odor Threshold	No data available
Particle size, shape, respirable fraction	No data available
Other physical hazards associated with process: Heat, gases under pressure, noise, vibration, ergonomic hazard	No data available
HEALTH HAZARDS	
Acute Toxicity	
Oral LD_{50}	Acute Tox 4-H302-Harmful if swallowed[25] Acute Oral LD50 is between 300 mg/kg and 2000 mg/kg (Wistar rats)[26] An oral dose of 2000 mg/kg of ADONA manifested hunched posture, uncoordinated movements, and piloerection and all rats died within 2 days of dosing. Necropsy revealed dark red foci of the mucosa of the glandular stomach. When all rats were administered with 300 mg/kg dose of ADONA they exhibited hunched posture for 1-2 days after dosing and survived to scheduled termination on day 15. No abnormal necropsy finding and no effects on body weight were observed at the dose of 300 mg/kg (Gordon, et al., 2011). [27] In the 5-day oral toxicity study in rats all females in the 298 mg/kg/day dose died between days 3 and 5. However, all males survived to scheduled termination and exhibited no clinical signs of toxicity. These females exhibited decreased activity, dramatically reduced food consumption, and had dark material on their fur at necropsy. Histopathologic examination of these animals revealed minimal to mild renal congestion, tubular dilation, and tubular degeneration/regeneration. Statistically significant findings in males during or at the end of the treatment period included: decreases in food consumption (approximately 19%),1 body weight (9%), body weight gain (50%), and red blood cell count (13%), and increases in platelets

	(68%), total bilirubin (41%), glucose (50%), urea nitrogen (71%), calcium (5%), chloride (4%), absolute liver weight (47%), and relative kidney weight (23%). Relative liver weight was also increased (57%) in this group (Gordon, et al., 2011).[28] In a 2007 developmental toxicity rat study, diluted ADONA was administered by gavage once daily at 0, 10, 30, 90, 270 and 500 mg/kg/day. 500 mg/kg dose group was terminated on GD 2 due to F0 maternal mortality (2 out of 10 rats).[29]
Dermal LD_{50}	Acute Dermal LD50 is greater than 2000 mg/kg (Wistar rats)[30] "All rats administered ADONA dermally at a dose of 2000 mg/kg for 24 h under semi-occluded conditions survived to scheduled termination on day 15. Clinical signs included mild erythema and scales at the test site, hunched posture, chromodacryorrhea, and piloerection. All clinical signs had fully resolved in all animals by day 9. There were no effects on body weight and no abnormal necropsy findings." (Gordon, et al., 2011) [31] (note: Formulation tested is 30% of the active ingredient in water; 2000 mg/kg of active ingredient)
Inhalation LC_{50}	No data available
Intraperitoneal LD_{50}	No data available
Chronic or Sub-chronic Toxicity	
IARC rating	No data available
Carcinogenicity	No data available
Neurotoxicity	No data available
Developmental/Reproductive Toxicity	The developmental toxicity screening study in rats revealed that at the dose of 500 mg/kg/day two rats did not survive after GD2, others showed significant body weight loss (mean 26.1 g), reduced food consumption, and clinical signs such as decreased activity, dehydration, cold to touch, pale extremities, rales, ungroomed coat, urine-stained fur, and ptosis (Gordon, et al., 2011).[32] At the dose of 270 mg/kg/day, 4 of 10 females were found dead between GD 3 – GD 5. Clinical signs were similar as observed in 500 mg/kg/day dose group but subsided in surviving animals after approximately 4 to 7 doses. Maternal food consumption during gestational period and postnatal period was reduced by 17% and 24% which was not statistically significant but absolute maternal weight reduction (mean 17.5 g) during GD 0-3 and mean body weight gain reduction (38%) during GD 0-20 was significant. The animal euthanized on GD 21 had one early resorption in utero and 12 dead fetuses. All females in the 90 and 30 mg/kg/day dose groups survived to scheduled termination (Gordon, et al., 2011). [33] The maternal and developmental NOAELs in this study were 30 mg/kg b.w./day[34]

Genotoxicity/Mutagenicity	"The weight of evidence from a battery of five genotoxicity studies indicates that ADONA is not directly genotoxic. ADONA did not induce mutations in reverse mutation assays in bacteria (S. typhimurium and E. coli) or in cultured mammalian (Chinese hamster V79) cells in either the presence or absence of metabolic activation. ADONA was not clastogenic at maximum tolerated oral doses in a micronucleus assay in mice or in a bone marrow cytogenetic study in rats." (Gordon, et al., 2011)[35]
Endocrine Disruption	No data available
Thyroid	Wistar rat repeat dose toxicity test showed increased incidence and severity of thyroid follicular hypertrophy up to 100 mg/kg in males; study authors considered this an adaptive change to the increases in liver weight and incidence and severity of hepatocellular hypertrophy/hyperplasia.[36]
Immunotoxicity	No data available
Other organ toxicity	Haematotoxicity and liver toxicity were observed in male rats at 10 mg/kg b.w. in a sub chronic oral rat study.[37] Increased levels of alkaline phosphatase (ALP), urea and inorganic phosphate were noted in males at 100 mg/kg/day. Glucose and potassium levels were increased in males at 20 and 100 mg/kg/day. Decreased level of bilirubin was noted in all males at 10, 30, and 100 mg/kg/day. Slight increased creatinine level and decreased calcium levels were noted in females at 100 mg/kg/day. No changes in clinical biochemical parameters were noted in females at 10 and 30 mg/kg/day. Absolute and relative liver weight was increased in males at 30 and 100 mg/kg/day. In addition relative liver weight was increased in males at 10 mg/kg/day. Slight increase in absolute and relative adrenal weight was noted in females at 100 mg/kg/day. This statistically significant change was slight and all values were within the physiological range. No clear dose response was noted. The NOAEL for the test article in this study was 10 mg/kg for males and 100 mg/kg for females.[38] ADONA in oral repeated dose studies was a possible PPARα agonist in male rats which have been shown to induce liver, Leydig-cell, and pancreatic acinar cell tumors in chronic studies of male rats. In oral repeated dose study, the liver was primary target organ in male rats and the kidney was primary target organ in female rats. (Gordon, et al., 2011)[39]
Skin, Eye and Respiratory Effects	
*Irritant – **S**kin, **E**ye, or **R**espiratory*	Eye Irritant 2-H319-Causes serious eye irritation[40]

	ADONA was a mild skin irritant and a moderate to severe eye irritant in rabbits. Researchers evaluated the ocular irritancy in New Zealand White rabbits according to OECD guideline 405.[41] 1 ml of the 30% stock solution of ADONA was instilled into one of the eyes of three male rabbits and contralateral eye of each rabbit was used as a control. Ocular examination was performed at 1, 24, 48, and 72 h and 7, 14, and 21 days following instillation. By using Fluorescein staining corneal epithelial damage was quantified. ADONA caused moderate to severe ocular irritation when instilled into eyes. "Mild corneal opacity (1.0/4.0) with epithelial damage affecting 20–75% of the corneal surface, neovascularization of the cornea, iridial irritation (1.0/2.0), moderate to severe conjunctival redness (2.6/3.0), chemosis (1.3/4.0), and discharge (1.3/3.0). These effects had fully resolved in all animals by day 21." (Gordon, et al., 2011)[42] 0.5 ml of the 30% stock solution of ADONA was applied to intact sites on the back of the rabbits to evaluate the primary dermal irritancy of ADONA. After daily observation of the sites for toxicity, the sites were examined and scored for erythema and edema. Results revealed slight to well-defined grade 1-2 erythema at the treatment sites of all three rabbits which resolved within 48 h in two male and 72h in one male, but no edema was observed. All rats gained weight and none of them showed any clinical sign of toxicity (Gordon, et al., 2011).[43]
Corrosive – ***S***, ***E***, *or* ***R***	The highest oral dose of 2000 mg/kg may be corrosive due to ADONA's surfactant properties (Gordon, et al., 2011).[44]
Permanent Damage – ***S***, ***E***, *or* ***R***	No data available
Sensitizer– ***S*** *&* ***R***	The dermal sensitizing potential of ADONA was evaluated in 2 murine local lymph node assays (LLNA) performing according to OECD guideline 429.[45] In the first assay, no clinical signs of toxicity, no effects on body weight, no macroscopic abnormalities, and no signs of irritation was observed but the auricular lymph node of 4 of 5 rats were slightly enlarged. In the second assay, all rats appeared normal and gained weight except one appeared emaciated, exhibited a wet anogenital area, and presented a small decrease in body weight on day 6. The authors did not consider these effects to be treatment-related since none of the other four animals in this dose group showed similar effects. ADONA is considered a weak dermal sensitizer based on the findings in both LLNA. (Gordon, et al., 2011).[46] Key study in REACH registration dossier: In vivo LLNA, SI values calculated for the 25, 50 and 100% concentrations were 1.8, 2.7 and 4.9

	respectively. The data showed a dose response and an EC3 value of 56.8% was calculated. Skin Sensitizer 1B-H317-May cause an allergic skin reaction[47]
Asthmagen – Initiator or Exacerbator	No data available
Skin Absorption, Kp	No data available
LOAEL	No data available
NOAEL	Rat maternal and developmental NOAELs were 30 mg/kg b.w/day (Gordon, et al., 2011).[48] NOAELs in 28- and 90-day oral studies in rats were 10 mg/kg/day for males and 100 mg/kg/day for females (Gordon, et al., 2011).[49] In a study of sub chronic oral rat NOAEL was 3 mg/kg b.w.[50]
Benchmark Dose Response (BMD)	No data available
Toxicokinetics	Mean human serum elimination half-life 23.3 days for three 3M workers potentially exposed to ADONA or its methyl ester.[51]
Metabolites	No data available
Synergistic or Antagonistic Effects	No data available
Environmental and Human Health Exposure and Risk Values	
RfC/RfD	No data available
ATSDR-MRL	No data available
Adverse Effect Levels: DNEL, PNEC, PNEL	No data available
Health Based Exposure Limits	
NIOSH-REL/IDLH/Ceiling Limits	No data available
OSHA-PEL	No data available
ACGIH TLV-TWA	No data available
TLV-STEL	No data available
Biomonitoring Action Limits	No data available
Drinking Water Standards	No data available on specific drinking water standards.
Other	"We determined human exposure to several perfluorinated substances and ADONA using blood plasma obtained from populations in South Germany with different exposure mainly via tap water. To our knowledge, this study reports the first measurements of ADONA in blood samples of the general population. Overall, the exposure of our study populations to ADONA is very low and health risks are unlikely because of its lower toxicity and shorter half-life compared to PFOA." (Fromme, et al., 2017).[52]
ENVIRONMENTAL & ECO-SYSTEM HAZARDS	
PBT	No data available

Persistent	**Hydrolysis:** hydrolytically stable; 0% after 5 days (OECD 111); hydrolysis half-life > 1 year. "Decomposition of ADONA by hydrolysis was not significant in all pH buffers tested (pH 4, 7, and 9) after 2.4 hours and 5 days at 50 °C." (unnamed study, 2007, GLP guideline study, Dyneon GmbH REACH submission)[53]
Bioaccumulation	**Biodegradation:** under test conditions no biodegradation observed (OECD 301B) ADONA is not readily biodegradable, nor will it be inherently biodegradable based on the structure of the anion. In addition, ADONA had a hydrolysis half life > 1 year based on test conducted under OECD Guideline 111 (Hydrolysis as a Function of pH). ADONA meets the criteria to be considered very persistent in the environment. (unnamed study, 2007, Dyneon GmbH REACH submission)[54] Not bioaccumulative in one common carp fish study: BCF in Cyprinus carpio: 0.1 mg/L a.i. dosage, 0.094 ± 0.0071; 1.0 mg/L a.i. dosage, 0.074 ± 0.012 (OECD 305)(unnamed study, 2009, Dyneon GmbH REACH submission)[55] In a study of predicting relative protein affinity of novel per- and polyfluoroalkyl substances by an efficient molecular dynamics approach, researchers found that there is a significant correlation between predicted energies of binding and measured binding affinities for human and rat liver type fatty acid binding protein (hLFABP and rLFABP). The replacements of PFASs, EEA and ADONA are at least as strongly bound to rLFABP as perfluorohepatonic acid, as strongly bound to hLFABP as perfluorooctanoic acid. Because interactions of PFASs with proteins are important determinants of bioaccumulation potential in organisms, these alternatives including ADONA could be as bioaccumulative as legacy PFASs. (Cheng, et al; 2018)[56]
BAF	No data available
BCF	5.40[57]
BMF	No data available
Ecological Toxicity	"Short-term ecotoxicity testing of ADONA has revealed no acute toxicity to aquatic organisms or activated sludge, and long-term ecotoxicity testing has shown no chronic toxicity in invertebrates or algae." (Dyneon GmbH REACH Submission)[58] In a study of Pan, et al., 2018 the mean Level of Detection in all samples of river was 0.02 ng/L and maximum level was 1.55 ng/L (Pan, et al., 2018).[59]

<table>
<tr><td>Aquatic Toxicity: LC_{50}, EC_{50}, ErC_{50}, NOAEC/NOEC</td><td>

Acute Toxicity[60]:

Species	Endpoint	Concentration[1] [mg/L]	Results parameter
Fish			
Danio rerio (zebra-fish)	96-hour LC50	> 100	mortality
Cyprinus carpio (carp)	96-hour LC50	> 1012	mortality
Invertebrate			
Daphnia magna (water flea)	48-hour EC50	> 100	immobilization
Chironomus riparius (midge)	96-hour EC50	> 1000	larval survival
Algae			
Pseudokirchneriella subcapitata (green algae)	96-hour EC50	> 1000	growth rate
Microorganism			
Activated sludge (domestic)	3-hour EC50	> 1000	respiration rate

Chronic Toxicity[61]:

Species	Endpoint	Concentration[1] [mg/L]	Results parameter
Invertebrate			
Daphnia magna (water flea)	21-day NOEC	100	reproduction
Algae			
Pseudokirchneriella subcapitata (green algae)	96-hour NOEC	1000	growth rate

1) Concentration for active ingredient, corrected for the purity of the test substance used.

</td></tr>
<tr><td>Mammalian Toxicity: LC_{50}, EC_{50}, ErC_{50}, NOAEC/NOEC</td><td>No data available</td></tr>
<tr><td>Wildlife Toxicity: LC_{50}, EC_{50}, ErC_{50}, NOAEC/NOEC</td><td>No data available</td></tr>
<tr><td>Breakdown/degradation /combustion products</td><td>ADONA is not significantly biodegraded in a ready biodegradation test (OECD 301B). No further biodegradation testing was performed, but the highly fluorinated anion is expected to be resistant to degradation in the environment.[62]

ADONA is volatile and starts to decompose thermally at 125°C with completion at 175°C. Decomposition leads to formation of more volatile substances.[63]</td></tr>
<tr><td>Anaerobic degradation</td><td>No data available</td></tr>
<tr><td>Aerobic degradation</td><td>No data available</td></tr>
<tr><td>Other observable ecological effects (e.g. BOD)</td><td>No data available</td></tr>
</table>

Fate and Transport: Aquatic	Fish biotransportation Half-Life (Km) 0.510 days.[64] "ADONA has an estimated log Koc <1.3 by HPLC. It is unlikely to bind to soil particles or sediments. ADONA, 30% solution, has a vapor pressure of 1900 Pa at 20 °C. As noted, this vapor pressure is due to the water itself rather than ADONA. Henry's Law constant was not measured for this substance, but as an ionic salt volatility is not expected." (Dyneon GmbH REACH Submission)[65]
Fate and Transport: Terrestrial	No data available
Fate and Transport: Atmospheric	No data available
Transport Issues	No data available
Factors affecting bioavailability	No data available
Global Environmental Impacts	
Ozone Depletion Potential (ODP)	No data available
Global Climate Change	No data available
Greenhouse Gas Production	No data available
Acid Rain Formation	No data available
Special Reports	
EU/Other Countries	No data available

[1] U.S. Environmental Protection Agency. Chemistry Dashboard. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#details
[2] DGUV – Deutsche Gesetzliche Unfallversicherung. Nov 2018 DNEL (Derived no-effect levels) list of the DGUV. Accessed at: https://www.dguv.de/medien/ifa/en/gestis/dnel/dnel-substance-list.xlsx.
[3] U.S. Environmental Protection Agency. Chemistry Dashboard. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#details
[4] U.S. Environmental Protection Agency. Chemistry Dashboard. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#details
[5] U.S. Environmental Protection Agency. Chemistry Dashboard. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#synonyms
[6] ECHA Information on registered Substances, accessed on 17APR2019 at: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/1
[7] U.S. Environmental Protection Agency. Chemistry Dashboard. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#details
[8] U.S. Environmental Protection Agency. Chemistry Dashboard. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#details
[9] OECD New Comprehensive Global Database of Per and Polyfluoroalkyl Substances, 2018. Accessed at: http://www.oecd.org/chemicalsafety/risk-management/global-database-of-per-and-polyfluoroalkyl-substances.xlsx
[10] ECHA Information on Registered Substances for ADONA CAS#: 958445-44-8; accessed at https://echa.europa.eu/substance-information/-/substanceinfo/100.105.293 on May 2, 2019.
[11] European Food Safety Authority (EFSA), Parma, Italy. Scientific Opinion on the safety evaluation of the substance, 3H-perfluoro-3-[(3-methoxy-propoxy) propanoic acid], ammonium salt, CAS No. 958445-44-8, for use in food contact materials, EFSA Panel on food contact materials, enzymes, flavorings and

processing aids (CEF). EFSA Journal 2011, 9(6):2182. Accessed at: https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/j.efsa.2011.2182

[12] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 65. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[13] ECHA Information on registered Substances for ADONA CAS#: 958445-44-8, accessed on 17APR2019 at: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/4/1

[14] U.S. Environmental Protection Agency. Chemistry Dashboard. Go to properties. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#properties

[15] ECHA Information on registered substances for ADONA CAS#: 958445-44-8, accessed on 6AUG2019: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/4/4

[16] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 65. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[17] U.S. Environmental Protection Agency. Chemistry Dashboard. Go to properties. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#properties

[18] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 65. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[19] U.S. Environmental Protection Agency. Chemistry Dashboard. Go to properties. Accessed at: https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID00874026#properties

[20] ECHA Information on registered substances for ADONA CAS#: 958445-44-8, accessed on 14AUG2019: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/4/12

[21] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 65. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[22] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 65. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[23] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 65. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[24] ECHA Information on Registered Substances for ADONA CAS#: 958445-44-8, accessed on 6AUG2019: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/4/23

[25] ECHA Information on Registered Substances for ADONA CAS#: 958445-44-8, accessed on 6AUG2019: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/7/3/2

[26] ECHA Information on registered substances for ADONA CAS#: 958445-44-8, accessed on 14AUG2019: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/7/3/1

[27] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 68. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

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[29] ECHA REACH Dyneon GmbH Registration Dossier for ADONA CAS#: 958445-44-8. Under Developmental toxicity/teratogenicity; unnamed 2007 study. Accessed at: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/7/9/3

[30] ECHA Information on registered substances for ADONA CAS#: 958445-44-8, accessed on 14AUG2019: https://echa.europa.eu/registration-dossier/-/registered-dossier/2602/7/3/1

[31] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 68. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[32] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 76. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[33] (Gordon, et al., 2011): Steven C. Gordon. Toxicological evaluation of ammonium 4,8-dioxa-3H-perfluorononanoate, a new emulsifier to replace ammonium perfluorooctanoate in fluoropolymer manufacturing. The journal of Regulatory Toxicology and Pharmacology 2011, 59(1): 76. Accessed at: https://www.sciencedirect.com/science/article/pii/S0273230010001686?via%3Dihub

[34] EFSA 2011. Scientific Opinion on the safety evaluation of the substance, 3H-perfluoro-3-[(3-methoxy-propoxy) propanoic acid], ammonium salt, CAS No. 958445-44-8, for use in food contact materials. European Food Safety Authority, EFSA Journal 2011; 9(6):2182 (p.7)

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