**Sustainable Futures**

**Summary Assessment**

**Using**

**P2 Framework Models**

This document was developed to help compile estimation results from U.S. EPA OPPT’s P2 Framework Models and is used by OPPT during Sustainable Futures (SF) training described at <http://www.epa.gov/opptintr/sf/> . Participants in the voluntary SF Pilot Project are asked to submit the information contained in this assessment along with their SF PMNs in their choice of format.

**Use of this specific format is not mandatory.**

**Chemical Assessed:**

Oxirane, 2-​methyl-​, polymer with oxirane, bis[2-​[(1-​oxo-​2-​propen-​1-​yl)​amino]​propyl] ether

**CAS Registry Number:**

1792208-65-1

**Participant Name:**

Xiao Huang

International Flavors & Fragrances Inc.

**Date of Assessment:**

Jul 1, 2016

|  |  |
| --- | --- |
| **Record ID:**  | **CAS No.** 1792208-65-1 |
| **Chemical Structure – Notified polymer** **C:\Users\xxh1219\Documents\GRA work\Notifications and Registrations\Malodor reactive polymers\Jeffamine diacrylamide.gif****The Mn of the notified polymer is approximately 1000 - 1100, containing low molecular weight oligomers. To be conservative, it is assessed as a Category 1 polymer, based on the following representative structure of a single organic molecule.** | **Mn (notified polymer): 1000-1100****MW (representative single molecule used for assessment): 342** |
| **MF (notified polymer):** C6H11NO2 . 1/2(C3H6O.C2 H4O)x**MF (representative single molecule used for assessment):** C17H30N2O5 |
| **Physical Form (notified polymer):** Pure polymer is solid, it is produced and used as a 50% solution in alcohol or aqueous solvents |
| **Submitter:** Xiao Huang (International Flavors & Fragrances Inc.) |
| **Trade Name:** TBD |
| **Use: Consumer, household, and industrial cleaning products** |
| **Production Volume:** 1,000 kg/yr (Projected – non US Mfg.) |
| **SMILES (representative single molecule used for assessment):** O=C(NC(C)COCCOC(C)COCC(C)NC(=O)C=C)C=C |
| **Name (notified polymer):** Oxirane, 2-​methyl-​, polymer with oxirane, bis[2-​[(1-​oxo-​2-​propen-​1-​yl)​amino]​propyl] ether |
| **Synonyms (notified polymer):** Jeffamine Diacrylamide |
| **SUSTAINABLE FUTURES SUMMARY:** |
| **Concern Level** | **HIGH** | **MODERATE** | **LOW** |
| **Persistence** |  | **X** |  |
| **Bioconcentration** |  |  | **X** |
| **Cancer Health Hazard** |  | **X** |  |
| **Non-Cancer Health Hazard** |  | **X** |  |
| **Aquatic Toxicity Hazard** |  | **X** |  |
| Is the chemical predicted to be a PBT by PBT Profiler? | **No** |
| **Overall Hazard Concern** | **Human Health Hazard:** **MODERATE****Aquatic Hazard: MODERATE** |
| **Overall Risk** | **Human Health Risk: LOW****Aquatic Risk: LOW** |

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| **CAS No.** 1792208-65-1 | **Submitter:** Xiao Huang (International Flavors & Fragrances Inc.) |
| PHYSICAL/CHEMICAL PROPERTIES: |
| **Melting Point (deg C)** | 215.18 (EPI) |
| **Boiling Point (deg C)** | 505.52 (EPI) |
| **Vapor Pressure (mm Hg)** | 1.88E-10 (EPI)  |
| **Water Solubility (g/L)** | 1.085 (EPI) |
| **Octanol/Water Partition Coefficient - Log Kow** | -0.59 (EPI) |
| **ENVIRONMENTAL TRANSPORT AND FATE:** |
| **Transport** |
| **Henry’s Law Constant – HLC (atm-m3/mol)** | 4.21E-17 (EPI, bond method); |
| **Soil Adsorption Coefficient – Log Koc**  | 1.438 (EPI, MCI method); |
| **Bioconcentration Factor – BCF** | 3.162 (EPI) |
| **Octanol-Air Partition Coefficient – Log Koa** | 14.174 (EPI) |
| Persistence |
| **Probability of Rapid Biodegradation (yes/no)** |  No (EPI) |
| **Expert Survey Result - Ultimate Biodeg Model** | Weeks – Months (EPI) |
| **Expert Survey Result - Primary Biodeg Model** |  Days – Weeks (EPI) |
| **MITI Biodegradation Probability (yes/no)** | No (EPI) |
| **Anaerobic Biodegradation Probability (yes/no)** | No (EPI) |
| **Atmospheric Oxidation Half-life** | 0.949hr [reaction with hydroxyl radicals] (EPI) |
| **Hydrolysis Half-life** | Not calculated |
| **Volatilization Half-life for Model River** | 1.072E+12 days (EPI) |
| **Volatilization Half-life for Model Lake** | 1.17E+13 days (EPI) |
| **Total Removal from Wastewater Treatment** **(also called “Sewage Treatment Plant”)** | 21.98% (EPI) |
| * **STP removal via biodegradation**
* **STP removal via sludge adsorption**
* **STP removal via stripping to air**
 | 20.53% (EPI)1.45% (EPI)0% (EPI) |
| **Additional Experimental Data** |  |
| Byproducts |
| **Degradation Products** | Not Assessed |
| **Metabolites** | Not Assessed |

\* Unless ***experimental*** data indicate otherwise, the maximum value used by EPA will be 90% removal.

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| **CAS No.** 1792208-65-1 | **Submitter:** Xiao Huang (International Flavors & Fragrances Inc.) |
| **ECOTOXICITY (ECOSAR 2.0 beta):** |
| **ECOSAR Chemical Class** | Neutral Organics |
| Acute Toxicity Profile |
| **Fish LC50** | 239 mg/L (ECOSAR) |
| **Daphnid LC50** | 597 mg/L (ECOSAR)  |
| **Green Algae EC50** | 1.70 mg/L (ECOSAR) |
| Chronic Toxicity Profile |
| **Fish ChV**  | 12.8 mg/L (ECOSAR) |
| **Daphnid ChV** | 2.73 mg/L (ECOSAR) |
| **Green Algae ChV** | 0.43 mg/L (ECOSAR) |
| **Hazard Summary** |
| **Overall Hazard Concern for Aquatic Toxicity** | **MODERATE** |
| **Lowest Chronic Concentration of Concern (COC)** | 40 ppb |
| **CANCER HEALTH EFFECTS:** |
| **Experimental Data**  | None identified |
| **OncoLogic Results** | OncoLogic8.0: MODERATE concern based on analysis of acrylamide function groups. |
| **Overall Hazard Concern for Carcinogenicity** | **MODERATE** |
| **NON-CANCER HEALTH EFFECTS:** |
| **Acute Toxicity** | No data.It can be presumed that the toxicity of the notified polymer, if any, would mainly be attributed to the acrylamide functional moieties of the low molecular weight oligomers; while the attached ethoxy-propoxy segment should lead to reduced reactivity and toxicity. As such, toxicity data of a small organic molecule with acrylamide functional group is used to represent a much worse case: CAS# 7646-67-5, N-(2-hydroxyethyl)prop-2-enamide,Rat oral gavage (OECD423) [[1]](#footnote-1) LD50 > 2000 mg/kg |
| **Irritation** | No data.Results1 based on CAS# 7646-67-5, N-(2-hydroxyethyl)prop-2-enamide (see rationale explained above):- not irritating to rabbit skin (OECD 404)- Irritating to rabbit eye, Category 1 (OECD 405) |
| **Skin Sensitizer** | The notified polymer showed minimal reactivity in Direct Peptide Reactivity Assay and predicted to be negative for skin sensitization potential *[IFF 2015, test report attached with PMN][[2]](#footnote-2).*The notified polymer was not predicted to have sensitization potential in KeratinoSens assay *[IFF 2015, test report attached with PMN][[3]](#footnote-3).* |
| **Reproductive and Developmental Effects** | No data.  |
| **Immune System Effects** | N/A |
| **Neurotoxicity** | N/A |
| **Genotoxicity** | Negative (+/- S9) in an *in vitro* mammalian micronucleus test using human peripheral blood lymphocytes following guideline OECD 487*. [IFF 2015, test report attached with PMN][[4]](#footnote-4)*  |
| **Mutagenicity** | Non-mutagenic under the conditions of an Ames test (+/- S9) following guideline OECD 471. *[IFF 2015, Test report attached with PMN][[5]](#footnote-5)*  |
| **Systemic Effects** | No data. Result1 based on CAS# 7646-67-5, N-(2-hydroxyethyl)prop-2-enamide (see rationale explained in “Acute toxicity” section):28-day repeat dose study (OECD 407)1, rat oral gavage, NOAEL = 50mg/kg/d |
| **Overall Hazard Concern for Non-Cancer** **Health Effects** | **LOW-MODERATE** |

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| **CAS No.** 1792208-65-1 | **Submitter:** Xiao Huang (International Flavors & Fragrances Inc.) |
| INDUSTRIAL OPERATIONS INFORMATION |
| **Operation Name** | Fragrance Liquid Compounding | **Number of sites** | One (1) |
| **Location** | International Flavors & Fragrances Inc. 600 State Highway #36, Hazlet, New Jersey 07730 | **Operating Days Per Year**  | 250 |
| **INDUSTRIAL RELEASE SUMMARY (ChemSteer)** |
| **Media** | **Operation** | **Daily Release (kg/site-day)** | **Release Days per Year** | **No of Sites of Release** | **Total Annual Releases (kg/year -all sites)** | **Release site information (NPDES No. or SIC Code)** |
| Water | Cleaning drums used to transport raw material at **drum reconditioning contractor’s site** | 3.12 | 10 | 1 | 30 | NPDES#: NJ0020141The Middlesex County Utility Authority |
| Equipment cleaning at **IFF** | 0.156 | 50 | 1 | 7.802 | NPDES #NJ0024708Bayshore Regional Sewerage Authority (BRSA) |
| Air | Cleaning drums used to transport raw material at **drum reconditioning contractor’s site** | 6.74E-16 | 10 | 1 | 6.47E-15 | SIC 5093 – Scrap and Waste Materials |
| Unloading raw material from drums at **IFF** | 3.64E-14 | 50 | 1 | 1.82E-12 | SIC 2844 – Soaps, detergent, etc. manufacture |
| Fugitive release during mixing operation at **IFF** | 1.86E-17 | 50 | 1 | 9.31E-16 | SIC 2844 – Soaps, detergent, etc. manufacture |
| Sampling product at **IFF** | 1.86E-17 | 50 | 1 | 9.31E-16 | SIC 2844 – Soaps, detergent, etc. manufacture |
| Equipment cleaning at **IFF** | 8.72E-14 | 50 | 1 | 4.36E-12 | SIC 2844 – Soaps, detergent, etc. manufacture |
| Loading product into containers at **IFF** | 2.02E-14 | 50 | 1 | 1.01E-12 | SIC 2844 – Soaps, detergent, etc. manufacture |
| Sludge incineration by **BRSA** | 2.26E-04 | 50 | 1 | 0.011 | NPDES #NJ0024708 (BRSA) |
| Land | Equipment cleaning wastewater on-site treatment at **IFF,** sludge sent to **PVSC** | 2.90E-03 | 50 | 1 | 0.145 | NJPDES #NJ 0108707/NJ0021016Passaic Valley Sewerage Commissions (PVSC)  |
| Cleaning drums used to transport raw material by drum reconditioning, wastewaterreleased to **MCUA,** sludge generated during treatment | 0.045 | 10 | 1 | 0.435 | NPDES#: NJ0020141The Middlesex County Utility Authority (MCUA) |
| **OCCUPATIONAL EXPOSURE SUMMARY** |
| **Operation** | **Route** | **Dose Rate (mg/day)** | **Days/yr** | **Workers**  | **Cancer LADD (mg/kg-day)** | **Chronic ADD****(mg/kg-day)** | **Acute APDR (mg/kg-day)** |
| Cleaning drums used to transport raw material | **Inhalation (Worst case)** | 3.23E-13 | 10 | 1 | 6.94E-17 | 1.22E-16 | 4.61E-15 |
| **Dermal (High end)** | 1123.5 | 10 | 1 | 0.241 | 0.422 | 16.05 |
| Unloading raw material from drums | **Inhalation (Worst case)** | 5.82E-10 | 50 | 1 | 6.51E-13 | 1.14E-12 | 8.32E-12 |
| **Dermal (High end)** | 1123.5 | 50 | 1 | 1.256 | 2.199 | 16.5 |
| Mixing operation | **Inhalation (Worst case)** | 2.68E-12 | 50 | 1 | 2.99E-15 | 5.24E-15 | 3.83E-14 |
| Sampling product | **Inhalation (Worst case)** | 2.68E-12 | 50 | 1 | 2.99E-15 | 5.24E-15 | 3.83E-14 |
| **Dermal (High end)** | 561.75 | 50 | 1 | 0.628 | 1.099 | 8.025 |
| Loading product into containers | **Inhalation (Worst case)** | 2.91E-09 | 50 | 1 | 3.25E-12 | 5.70E-12 | 4.16E-11 |
| **Dermal (High end)** | 112.4 | 50 | 1 | 0.126 | 0.220 | 1.605 |
| Equipment cleaning | **Inhalation (Worst case)** | 4.75E-11 | 50 | 1 | 5.32E-14 | 9.31E-14 | 9.31E-14 |
| **Total number of Workers – All Sites** | 45 |
| **GENERAL POPULATION EXPOSURE SUMMARY (E-FAST)** |
| Drum handling: The total annual quantity of PMN substance (based on 100% new chemical substance) for processing will be 1000 kg. The substance is produced and used as a 50% solution in alcohol or aqueous solvents, i.e., total amount of solutions processed will be 2000kg, stored in 8-12 drums. Once the drums are emptied, they are transported (with other empty used drums) via approved transport to an approved drum reconditioning contractor who cleans, crushes and shreds the containers. The scrap metal is then recycled. * The approved contractor for drum removal is: Recycle Inc. East, 20-A Harmich Road, South Plainfield, N.J. 07080, EPA ID#: NJ000007153
* Drum wash waters are sent to: The Middlesex County Utility Authority (**MCUA**), P. O. Box 159, Main St., Sayreville, N.J. NJPDES#: NJ0020141.

On-Site Treatment: All industrial wastewaters that exit the compounding facility are pretreated via a permitted, Sequencing Batch Reactor (SBR), waste activated sludge facility and then discharged to the local POTW, Bayshore Regional Sewerage Authority (**BRSA**), NJPDES# NJ0024708.All sludge generated at the On-site Wastewater Pretreatment Plant of the IFF Manufacturing Facility is sent to Passaic Valley Sewerage Commissions (**PVSC**), NJPDES #NJ 0108707/NJ0021016, for further treatment and eventual disposal.Off-Site Treatment (POTW): The wastewater enters the POTW - BRSA. The treated effluent from the POTW is combined with the waters from other municipalities. This total flow is then managed and discharged through the Monmouth County Bayshore Outfall Authority into the Atlantic Ocean, approximately 2,000 feet offshore. Sludge generated at BRSA is incinerated at their facility located in Union Beach, New Jersey.Following is a schematic diagram depicting the industrial releases.Fugitive(Air)IFF compounding sitePMN material in drumsEmpty drumsIndustrial wastewater (WW)IFF on-site WW treatmentDrum reconditioning contractorDrum wash water**MCUA**NJPDES#: NJ0020141Treated WW Sludge**BRSA**NJPDES#: NJ0024708Pretreated WWSludge**PVSC**NJPDES#: NJ0108707NJ0021016Treated WWDisposal(Land)Release (Water)Disposal(Land)SludgeSludgeIncineration(Air)Release (Water)Fugitive(Air) |
| **EXPOSURE from RELEASES by the DRUM RECONDITIONING CONTRACTOR** |
| **HUMAN EXPOSURE** |
|  | **Cancer LADDpot****(mg/kg-day)** | **Chronic ADDpot****(mg/kg-day)** | Acute ADRpot(mg/kg-day) |
| **Fish Ingestion** | 2.61E-09 | 4.89E-09 | 1.67E-05 |
| **Fugitive Emissions** | 1.56E-20 | 2.93E-20 | 1.69E-17 |
| **Landfill Leaching** | 1.88E-07 | 3.53E-07 | N/A |
| **AQUATIC EXPOSURE SUMMARY** |
| **Predicted Environmental Concentration (PEC)** | Acute 1.52 ug/l [ppb] (in Raritan Bay)Chronic 0.76 ug/l [ppb] (in Raritan Bay) |
| **PEC Exceeds Chronic COC (days / year)** | 0 days/yr |
| **EXPOSURE from RELEASES by IFF OPERATION SITE and through POTWs (BRSA and PVSA)** |
| **HUMAN EXPOSURE** |
|  | **Cancer LADDpot****(mg/kg-day)** | **Chronic ADDpot****(mg/kg-day)** | Acute ADRpot(mg/kg-day) |
| **Fish Ingestion (BRSA)** | 1.27E-09 | 2.38E-09 | 2.22E-06 |
| **Incineration Emission (BRSA)** | 3.23E-09 | 6.06E-09 | 2.78E-07 |
| **Fugitive Emissions (Unloading raw materials from drums on-site)** | 4.22E-18 | 7.91E-18 | 9.10E-16 |
| **Fugitive Emissions (Mixing operation on-site)** | 2.16E-21 | 4.05E-21 | 4.65E-19 |
| **Fugitive Emissions (Sampling product on-site)** | 2.16E-21 | 4.05E-21 | 4.65E-19 |
| **Fugitive Emissions (Equipment cleaning on-site)** | 1.01E-17 | 1.89E-17 | 2.18E-15 |
| **Fugitive Emissions (Loading product into containers on-site)** | 2.34E-18 | 4.39E-18 | 5.05E-16 |
| **Landfill Leaching (PVSA)** | 6.02E-08 | 1.13E-07 | N/A |
| **AQUATIC EXPOSURE SUMMARY** |
| **Predicted Environmental Concentration (PEC)** | Acute 0.2 ug/l [ppb] (in Atlantic Ocean)Chronic 7.41E-02 ug/l [ppb] (in Atlantic Ocean) |
| **PEC Exceeds Chronic COC (days / year)** | 0 |
| **EXPOSURE from HOUSEHOLD PRODUCTS USAGE (DOWN The DRAIN RELEASE)** |
| **HUMAN EXPOSURE** |
|  | **Cancer LADDpot****(mg/kg-day)** | **Chronic ADDpot****(mg/kg-day)** | Acute ADRpot(mg/kg-day) |
| **Drinking water (10th percentile)** | 2.27E-08 | 4.26E-08 | 3.98E-07 |
| **Fish Ingestion (10th percentile)** | 5.16E-10 | 9.68E-10 | 1.16E-07 |
| **AQUATIC EXPOSURE SUMMARY** |
| **Predicted Environmental Concentration (PEC) (10th percentile 7Q10)** | 1.89E-02 ug/l [ppb] |
| **PEC Exceeds Chronic COC (days / year)** | 0 |
| **CONSUMER EXPOSURE FROM END-USES of HOUSEHOLD PRODUCTS** |
| Consumer product weight fraction: 2% (Maximum) |
|  | **Cancer LADDpot****(mg/kg-day)** | **Chronic ADDpot****(mg/kg-day)** | Acute ADRpot(mg/kg-day) |
| **Dermal – Consumer Use** | **General Cleaner** | 5.16E-03 | 9.68E-03 | 8.59E-03 |
| **Laundry detergent** | 2.84E-04 | 5.33E-04 | 2.73E-03 |
| **Bar Soap** | 3.27E-02 | 6.13E-02 | 4.92E-02 |
| **Inhalation – Consumer Use** | Negligible |
| **HUMAN GENERAL POPULATION OVERALL EXPOSURE** |
|  | **Cancer LADDpot****(mg/kg-day)** | **Chronic ADDpot****(mg/kg-day)** | Acute ADRpot(mg/kg-day) |
| **All exposure routs/scenarios combined** | 3.81E-02 | 7.15E-02 | 6.05E-02 |
| **RISK ASSESSMENT CALCULATIONS and SUMMARY:** |
| **Acute Risk to Aquatic Organisms** | **LOW CONCERN.**Based on PEC and Acute COC.**(See below Worksheet #1 for details.)** |
| **Chronic Risk to Aquatic Organisms** | **LOW CONCERN.**Based on PEC and Chronic COC.**(See below Worksheet #2 for details.)** |
| **MOE – Acute Occupational Exposure** | **LOW CONCERN.** LD50 > 2000mg/kg for N-(2-hydroxyethyl)prop-2-enamide (CAS# 7646-67-5) |
| **MOE – Chronic Occupational Exposure** | **LOW CONCERN with proper PPE.** Based on Chronic ADD for inhalation and dermal exposure and NOAEL for systemic effects of N-(2-hydroxyethyl)prop-2-enamide (CAS# 7646-67-5).**(See below Worksheet #3 for details.)** |
| **MOE – Acute General Population Exposure** | **LOW CONCERN.** LD50 > 2000mg/kg for N-(2-hydroxyethyl)prop-2-enamide (CAS# 7646-67-5) |
| **MOE – Chronic General Population Exposure** |  **LOW CONCERN.** Based on Chronic ADD for inhalation and dermal exposure and NOAEL for systemic effects of N-(2-hydroxyethyl)prop-2-enamide (CAS# 7646-67-5).**(See below Worksheet #3 for details.)** |

* **Worksheet#1: Identification of Acute Risk to Aquatic Organisms:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Acute Endpoint** | **Value** | **Factor** | **Acute COC** | **PEC** | **Potential for Risk?** |
| Fish LC50 | 239 ppm | 5 | 50 ppm | 1.52ppb | **Low concern** |
| Daphnia LC50 | 597 ppm  | 5 | 100 ppm | 1.52ppb | **Low concern** |
| Algae EC50 | 1.70 ppm | 4 | 400 ppb | 1.52ppb | **Low concern** |

* **Worksheet#2: Identification of Chronic Risk to Aquatic Organisms:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Chronic Endpoint** | **Value** | **Factor** | **Chronic COC** | **PEC** | **Potential for Risk?** |
| Fish ChV | 12.8 ppm  | 10 | 1000 ppb | 0.76ppb | **Low concern** |
| Daphnia ChV | 2.73 ppm | 10 | 300 ppb | 0.76ppb | **Low concern** |
| Algae ChV | 0.43 ppm | 10 | 40 ppb | 0.76ppb | **Low concern** |

* **Worksheet #3: Identification of Non-Cancer Human Health Risk**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Effect** | **NOAEL** | **Type of Exposure** | **Exposure (ChemSteer Chronic ADD or E-FAST Chronic ADDpot), mg/kg-d** | **MOE** | **Potential for Risk?** |
| Systemic effects [N-(2-hydroxyethyl)prop-2-enamide (CAS# 7646-67-5)] | 50 mg/kg-d | **General Population** | 3.81E-02 (aggregated) | **1312** | **Low concern** |
| Worker (cleaning drums) | 1.22E-16 (inhalation) | 4.12E17 | **Low concern** |
| 0.422 (dermal) | 118 | **Low concern** |
| Worker (unloading raw material from drums) | 1.14E-12 (inhalation) | 4.4E13 | **Low concern** |
| 2.199 (dermal) | 23 | Yes (without PPE);**Low Concern (with proper PPE)\*** |
| Worker (mixing operation) | 5.24E-15 (inhalation) | 9.5E15 | **Low concern** |
| Worker (sampling product) | 5.24E-15 (inhalation) | 9.5E15 | **Low concern** |
| 1.099 (dermal) | 45 | Yes (without PPE);**Low Concern (with proper PPE)\*** |
| Worker (loading product into containers) | 5.70E-12 (inhalation) | 8.8E12 | **Low concern** |
| 0.220 (dermal) | 227 | **Low concern** |
| Worker (cleaning equipment) | 9.31E-14 (inhalation) | 5.4E14 | **Low concern** |

\*The exposure is mainly from dermal contact, which is a high-end estimate from the EPA/OPPT 2-Hand or 1-Hand Dermal Contact with Liquid Model. Given the fact that workers at IFF and the drum reconditioning contractor facilities are required to wear chemical resistant gloves and other personal protective equipment (PPE), actual dermal exposure of the material is expected to be minimal if any. In addition, the NOAEL is based on a small organic molecule with acrylamide functional group, which represents a much worse case comparing to the notified polymer from reactivity and toxicity point of view. Overall, the potential risk is expected to be very low with proper PPE.

1. ECHA website, <http://echa.europa.eu/registration-dossier/-/registered-dossier/1191> [↑](#footnote-ref-1)
2. IFF test report, Direct Peptide Reactivity Assay (DPRA), 2015. [↑](#footnote-ref-2)
3. IFF test report, Induction of Antioxidant-Response-Element Dependent Gene Activity and Cytotoxicity (Using MTT) in the Keratinocyte ARE-Reporter Cell Line Keratinosens, 2015. [↑](#footnote-ref-3)
4. IFF test report, *In Vitro* Mammalian Cell Micronucleus Assay in Human Peripheral Blood Lymphocytes (HPBL), OECD 487, 2015 [↑](#footnote-ref-4)
5. IFF test report, Bacterial Reverse Mutation Assay, OECD 471, 2015. [↑](#footnote-ref-5)