*Flex*ible Formulations:

Business Leaders Shed Light on 1,4-Dioxane

November 20, 2019

Today's Panelists

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Agenda

- Market Overview
- 1,4-Dioxane regulations and what they mean for your business
- Implications of 1,4-Dioxane limits on finished formulations
- Proactive steps taken by BASF
- Summary
- Questions

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Where is the market going?

Megatrends shape our perspective.

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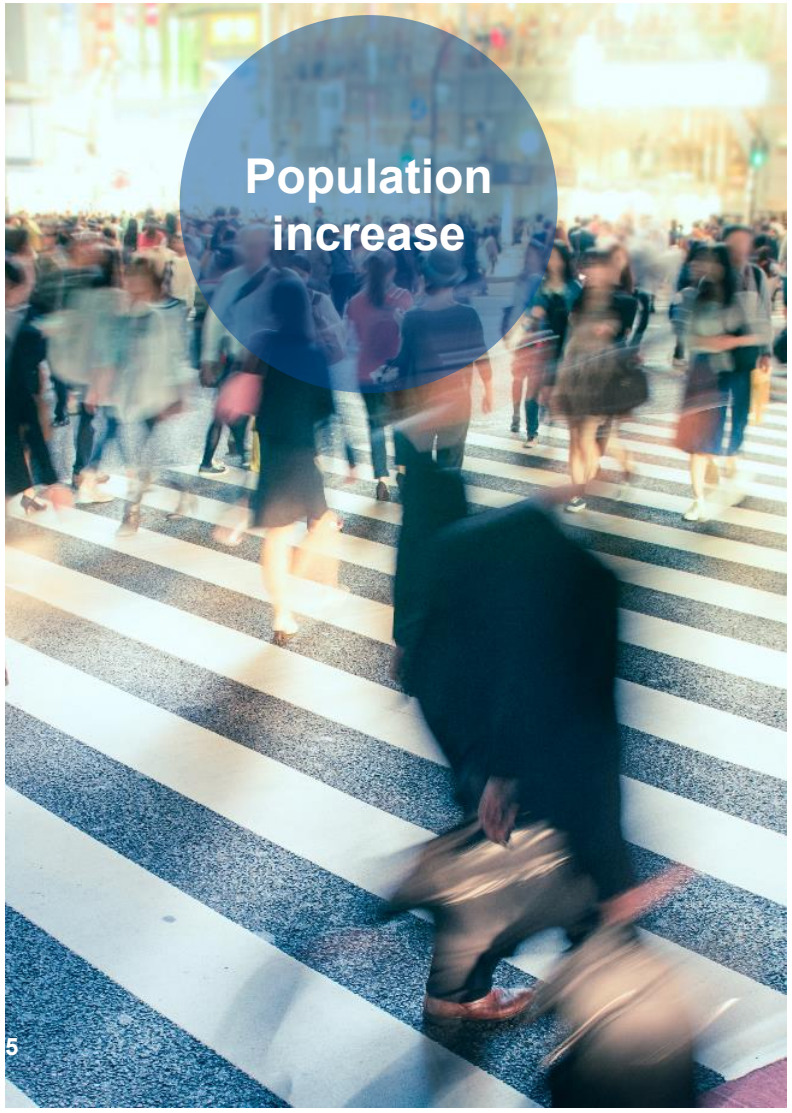
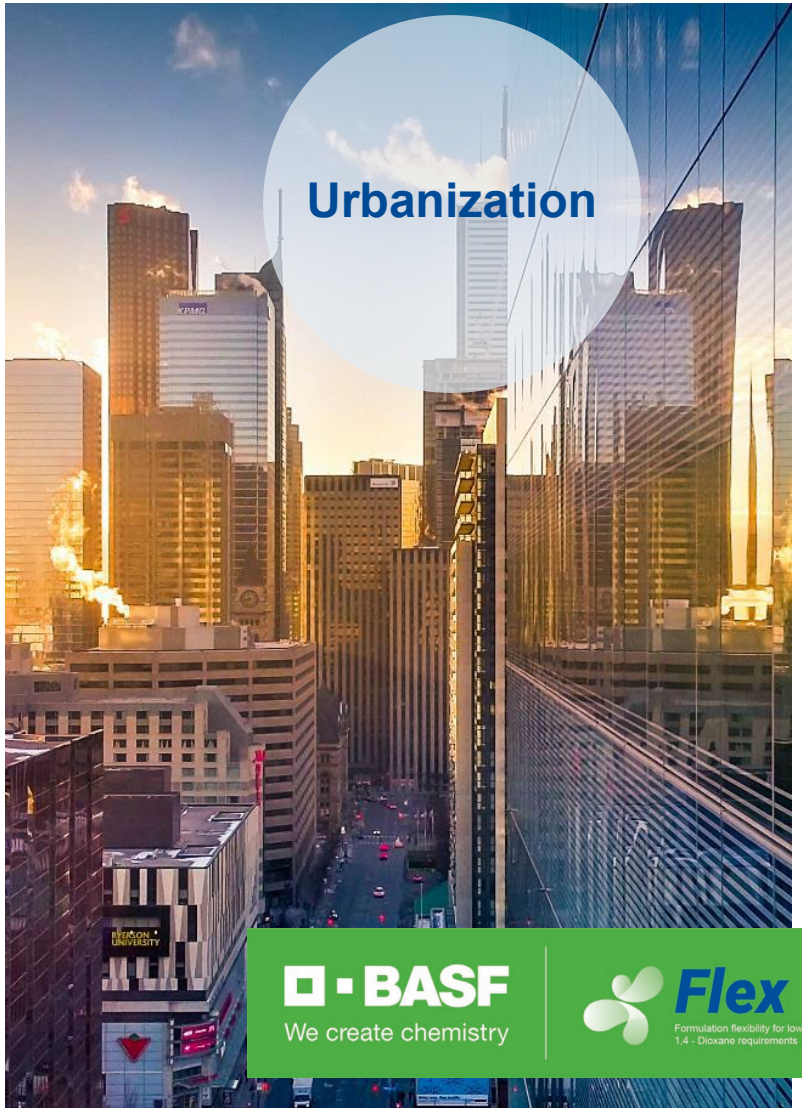
Megatrends driving sustainable needs





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Our sustainable path forward

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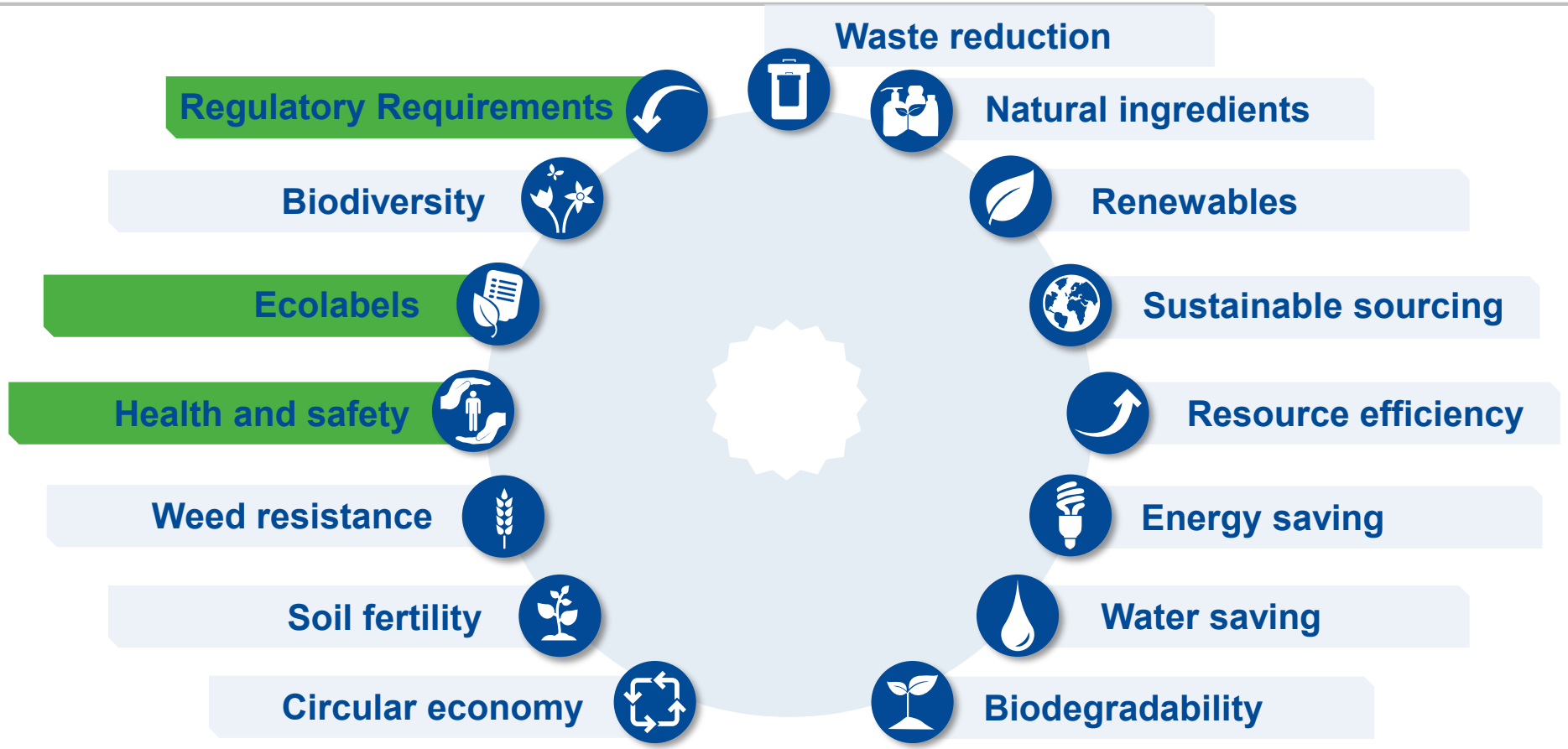
Sustainable needs in our customers' industries



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Navigating a new landscape: emerging 1,4-Dioxane regulation

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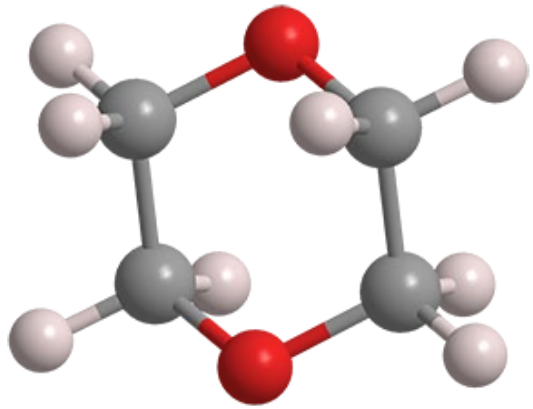
Background: What is 1,4-Dioxane?

- 1,4-Dioxane is a synthetic chemical primarily used as a solvent and historically as a stabilizer for chlorinated solvents used in commercial and industrial applications.
- It can also be found as an impurity in household products such as deodorants, shampoos, toothpastes, and cleaning products.
- 1,4-Dioxane forms as a byproduct during the manufacturing process of certain surfactants and emulsifiers produced with ethylene oxide
- 1,4-Dioxane is completely miscible in water



11/20/2019 | https://www.epa.gov/sites/production/files/2014-03/documents/ffrro_factsheet_contaminant_14-dioxane_january2014_final.pdf
https://www.fda.gov/cosmetics/potential-contaminants-cosmetics/14-dioxane-cosmetics-manufacturing-byproduct

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What is the concern about 1,4-Dioxane?

- EPA has classified 1,4-Dioxane as “likely to be carcinogenic to humans” by all routes of exposure (per EPA IRIS 2013)
- A 2016 report by the Department of Health and Human Services National Toxicology Program (NTP) found that 1,4-dioxane is “reasonably anticipated to be a human carcinogen based on sufficient evidence of carcinogenicity from studies in experimental animals”
- The data available from human epidemiological studies are not adequate to evaluate the relationship between human cancer and exposure to 1,4-dioxane.

 | https://www.epa.gov/sites/production/files/2014-03/documents/ffrro_factsheet_contaminant_14-dioxane_january2014_final.pdf
https://www.fda.gov/cosmetics/potential-contaminants-cosmetics/14-dioxane-cosmetics-manufacturing-byproduct

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Elevated 1,4-Dioxane levels found in NY groundwater in 2016

- 2016: the Environmental Protection Agency (EPA) found >/= 1ppb levels of 1,4-Dioxane in groundwater in New York; highest levels are in Long Island.
- EPA risk assessments indicate that the drinking water concentration representing a 1 x 10^{-6} cancer risk level for 1,4-dioxane is 0.35 µg/L (0.35 ppb) (EPA IRIS 2013)
- No federal maximum contaminant level (MCL) for drinking water has been established (EPA 2012). NY State Department of Health working on establishing an MCL for 1,4 dioxane in drinking water.

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NY State legislature bill targets Home + Personal Care products

- **June 2019:** New York State Senate and Assembly passed a bill to limit presence of 1,4-Dioxane in Household Cleaning products, Cosmetic products and Personal Care products.
- **Status:** It has yet to be delivered to the Governor's office. Decision by Dec. 31, 2019
- **Ongoing Actions:** ACI, HCPA and allied trades seeking chapter amendment.

NY Bill 1,4-Dioxane Limit Restrictions Summarized	
Household Cleaning Products + Personal Care Products	• 2 ppm by Dec. 31, 2022 • 1 ppm by Dec. 31, 2023 • 2025: Department of Environmental Conservation in consultation with the Department of Health can determine, by rule, if the "trace concentration threshold shall be lowered to better protect human health and the environment"
Cosmetic Products	• 10 ppm by Dec. 31, 2022 • 2025: Department of Environmental Conservation in consultation with the Department of Health can determine, by rule, if the "trace concentration threshold shall be lowered to better protect human health and the environment"

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Additional legal complexities face Home, Personal Care industries

California

- California Right to Know Act (2017)
  - CPRKA
  - SB 258
- Manufacturers of cleaning products sold in California must post the following information (and more) on their websites by Jan 2020 and on labels by Jan 2021:
  - “intentionally added” ingredients
  - “nonfunctional constituents” at concentrations at or above 100 ppm
  - 1,4-Dioxane specifically set at >=10ppm
  - CAS
  - functional purpose served of intentionally added ingredient
- Safer Consumer Products Evaluation
  - State Department of Toxic Substances Control (DTSC) is assessing 1,4 Dioxane in HC and PC product(s) through Safer Consumer Products program
  - Public comment period closed August 30, 2019
  - Estimated to be completed in ~3 years.

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What does this mean for your business? Implications on finished formulas.

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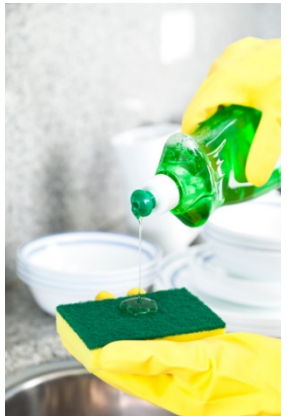
Estimated Typical 1,4-Dioxane Content in Manual Dish + Laundry

Typical Manual Detergent			2-36 ppm 1,4-dioxane
Description	**Typical 1,4-Dioxane level (ppm)**	**Typical Use Levels**	**Contribution of 1,4-Dioxane in the bottle (PPM)**
Alkyl Ether Sulfate (70% active)	20-100	12-35%	2-36
Nonionic Surfactant (Alkyl Ether)	1	0-5%	0-0.05



Typical 2X Liquid Laundry Detergent			1-15 ppm 1,4-dioxane
Description	**Typical 1,4-Dioxane level (ppm)**	**Typical Use Levels**	**Contribution of 1,4-Dioxane in the bottle (PPM)**
Alkyl Ether Sulfate (70% active)	20-100	5-15%	1-15
Nonionic Surfactant (Alkyl Ether)	1	0-10%	0-0.10

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Estimated Typical 1,4 Dioxane in Shampoo

Typical Shampoo			Total 1,4-dioxane	2.42 – 5.1ppm
Ingredient Type	**Description**	**Typical 1,4 dioxane level (ppm)**	**Typical Use Levels**	**1,4-Dioxane in the bottle (ppm)**
Primary Surfactant	SLES	30	8-16%	2.4 – 4.8
Secondary Surfactant	Betaines, Alkanolamides, Amphoacetates, APGs, Glutamates	0	2-5%	0
Conditioning Agents/Polymers	Polyquaterniums, Cationic Guar, Cationic/Acrylamide Copolymers, Esterquats	0	0.1-3%	0
Pearlizers/Effect Pigments	Glycol Distearate, Glycol Stearate, Blends	1	0-5%	0.0 – 0.05
Thickeners/Rheology Modifiers	Acrylates Copolymers PEG/PPG-120/10 Trimethylolpropane Trioleate	1	2-5%	0.02 – 0.05
Care Ingredients/Actives	Emollients (ethers/esters), Panthenol, Keratin, Micro Emulsions, Wax Dispersions, Shea Butter, Triglycerides	0	0-3%	0
Solubilizers	Polysorbates, PEG derivatized Castor Oil, Ethoxylated Alcohols	10	0-2%	0.0 – 0.2
Chelating Agents/Stabilizers	EDTA, Pentaerythrityl tetra-di-t-butyl hydroxyhydrocinnamate	0	0-1%	0

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Estimated Typical 1,4 Dioxane in Toothpaste

Typical Toothpaste			Total 1,4-dioxane	.07 - 0.8
Ingredient Type	**Description**	**Typical 1,4 dioxane level (ppm)**	**Typical Use Levels**	**1,4-Dioxane in the bottle (ppm)**
Abrasives	Hydrated silica, alumina, calcium carbonate	0	10-50%	0
Binders/Rheology Modifiers	Xanthan gum, carboxymethyl cellulose (CMC) carbomers, carrageenan; PEG/PPG-116/66 Copolymer, PEGs	10	0.5-7%	0.05 – 0.7
Humectant	Sorbitol, Glycerin	0	20-60%	0
Surfactant	Sodium lauryl sulfate, cocamidopropyl betaine, poloxamer	5	0.3-2%	0.02 – 0.1
Colorant	Dyes, Effect pigments	0	0.1-1.5%	0
Flavors	Menthol, peppermint, spearmint, green tea, sodium saccharin	0	0.5-2%	0
Actives	Bisabolol, Panthenol, Vitamins, Bioactives	0	0-1%	0
Fluoride	Sodium Fluoride, MFP, Stannous Fluoride	0	0-0.25%	0
Preservatives/ Sweetener	Sodium Benzoate, Saccharin,Stevia	0	0-1.0%	0

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How should you navigate this complex landscape?

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BASF is a market leader in low 1,4 Dioxane solutions

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Engaged Advocacy

Our Customers

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BASF is actively advocating on behalf of our industry and can help you navigate the implications of new regulation.

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Market-leading Technology

State of the art manufacturing and analytical technology

High testing frequency at all production sites

Consistently low levels of 1,4-Dioxane

NEW ultra-low 1,4-Dioxane line of products

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BASF launches first of many *Flex* products for formulation *Flex*ibility

New alternatives to existing products offer *guaranteed* low 1,4-Dioxane levels, certified at batch level on every COA

Market	Product Name	1,4-Dioxane Current Specification Limit (ppm)	1,4-Dioxane FLEX Specification Limit (ppm)
Personal Care 	Pluracare® F 127 NF PR FLEX	5	1
	Pluracare® E400 NF PEG FLEX	10	1
	Pluracare® E600 NF PEG FLEX	10	1
Home Care I&I 	Pluriol® E 8000 E FLEX	Not listed on CoA	1
	Pluriol® E 600 LS FLEX	Not listed on CoA	1
	Pluriol® E 400 LS FLEX	Not listed on CoA	1
Standard Surfactants 	Texapon® N 70 NA FlexGold	N/A	5
	Texapon® N 70 NA FlexSilver	N/A	10

More *Flex* products to be launched soon

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Formulation Expertise

Our experienced formulators have evaluated over 20 industry standard formulations across home and personal care.

What does that mean for you?

We understand:

- The relative risk of formulas
- Ingredients that are the greatest 1,4-Dioxane contributors

BASF Solutions:

- Alternative ingredients that do not contain 1,4-Dioxane
- Formulations with no or low-1,4-Dioxane content
- Technical guidance for your reformulation and replacement efforts

Most importantly, we can help you focus your resources.

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Start now—Here's how to prioritize:

Personal Care

Formulations:

- Shampoo
- Hair Pomades/Waxes
- Toothpaste

Ingredients:

- PEGs and PEG-derivatized castor oils
- Ethoxylated alcohols
- Fatty alcohol mixed with ethoxylates
- Alkyl ether sulfates (SLES)
- Glycol distearates
- Glycol distearate blends
- EO/PO Block Copolymers

Home Care

Formulations:

- Manual dish
- Liquid Laundry
- Laundry single-dose
- Fragrance enhancers

Ingredients:

- Alkyl Ether Sulfate (SLES)
- Ethoxylated alcohols
- PEGs
- EO/PO Block Copolymers
- Other Polymers containing EO

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3 Steps for Low 1,4-Dioxane Manual Dish + Laundry Formulation

1. Rebalance Anionic Surfactants	• Texapon® LS 30 NA + Standapol® WAQ-LCK (SLS) • Texapon® N 70 NA FlexGold (SLES with low 1,4-Dioxane) • Texapon® N 70 FlexSilver (SLES with low 1,4-Dioxane)
2. Increase Surfactants that synergize with anionics	• Glucopon® Surfactants • Pluronic® surfactants • Dehyton® PK 45 (cocoamidopropyl betaine)
3. Introduce Performance Boosting Polymers	• Sokalan® HP 20 • Sokalan® HP 96

1. Rebalance Anionic Surfactants	• Texapon® LS 30 NA + Standapol® WAQ-LCK (SLS) • Texapon® N 70 NA FlexGold + FlexSilver (SLES with low 1,4-Dioxane)
2. Increase ingredients that clean without surfactants	• Trilon® Chelating Agents • Lavergy™ Pro 104
3. Introduce Performance Boosting Polymers	• Sokalan® HP 20 • Sokalan® HP 96 • Sokalan® HP 22 G • Trilon® P

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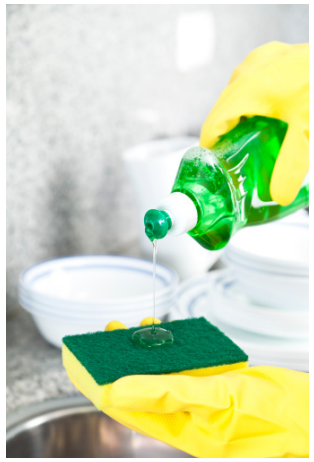
Reformulated Manual Dish + Laundry w/ low 1,4-Dioxane ingredients

BASF NY Compliant Formula (surfactant system only)	Premium Manual Dish Detergent UL Prospector Formula C653-131-2			0.7 ppm
Description	**BASF Products**	**1,4-Dioxane maximum (ppm)**	**Use level (as supplied)**	**1,4 dioxane in the bottle (PPM)**
Alkyl Ether Sulfate (70% active)	Texapon® N 70 NA FlexGold	5	14%	0.7
Nonionic Surfactant (Alkylpolyglucoside)	Glucopon® 600 UP	0	10%	0
LAS Surfactant, 40% sodium salt	N/A	0	25%	0



BASF NY Compliant Formula (surfactant system only)	Liquid Laundry Detergent UL Prospector formula C653-33-1A			0 ppm
Description	**BASF Products**	**1,4-Dioxane maximum (ppm)**	**Use level (as supplied)**	**1,4 dioxane in the bottle (PPM)**
Sodium lauryl sulfate, 25% active	Standapol WAQ-LCK	0	47.4%	0
C10-C16 Alkylpolyglucoside	Glucopon 600 UP	0	18.0%	0
Coconut Fatty Acid	N/A	0	3.5%	0

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Three steps to low 1,4-Dioxane Personal Care Formulations

SHAMPOO

1. Rebalance primary surfactant system with SLS, or Texapon N 70 NA FlexGold + FlexSilver	• Texapon® K 12 P or G • Standapol® WAQ-LCK (SLS) • Texapon N 70 FlexGold and FlexSilver (SLES with guaranteed low 1,4-Dioxane)
2. Use a combination of sulfate-free and non-ethoxylated surfactants	• Plantaren ® APGs • Plantapon LGC Sorb • Jordapon SCI • Dehyton® PK 45 (cocoamidopropyl betaine)
3. Switch to low or no dioxane rheology modifiers and solubilizers	• Arlypon F • Eumulgin SML 20 • Eumulgin VL 75

TOOTHPASTE

1. Replace PEGs and Poloxamers with *Flex* line	• Pluracare F 127 NF PR FLEX • Pluracare E 400 NF PEG FLEX + E 600 NF PEG FLEX
2. Rebalance water content to rheology modifier ratio	• Rheocare ® XGN • Pluracare L 1220 • Pluracare F 127 NF PR FLEX
3. Switch to non-ethoxylated surfactants	• Plantaren ® APGs • Texapon® K 12 P or G

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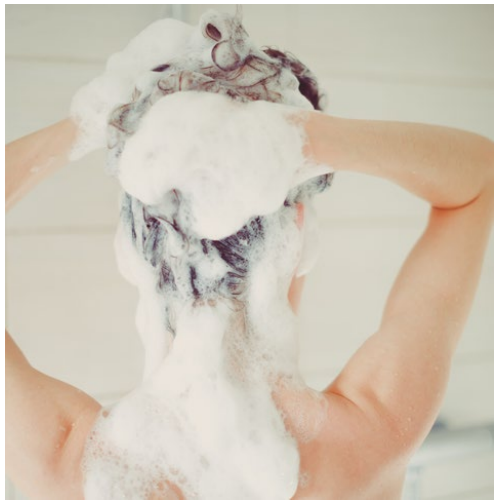
Reformulated Shampoo with low 1,4-Dioxane Ingredients

BASF NY Compliant Formula			Total 1,4-dioxane	0.42 – 0.92ppm
Ingredient Type	**BASF Product**	**1,4 dioxane Maximum (ppm)**	**Typical Use Levels**	**1,4-Dioxane in the bottle (ppm)**
Primary Surfactant	**Texapon ® N 70 NA FlexGold** (SLES)	5	8-16%	0.4 – 0.8
Secondary Surfactant	Betaines, Alkanolamides, Amphoacetates, APGs, Glutamates	0	2-5%	0
Conditioning Agents/Polymers	Polyquaterniums, Cationic Guar, Cationic/Acrylamide Copolymers, Esterquats	0	0.1-3%	0
Pearlizers/Effect Pigments	Glycol Distearate, Glycol Stearate, Blends	1	0-5%	0.0 – 0.05
Thickeners/Rheology Modifiers	Acrylates Copolymers PEG/PPG-120/10 Trimethylolpropane Trioleate	1	2-5%	0.02 – 0.05
Care Ingredients/Actives	Emollients (ethers/esters), Panthenol, Keratin, Micro Emulsions, Wax Dispersions, Shea Butter, Triglycerides	0	0-3%	0
Solubilizers	**Eumulgin SML 20**	1	0-2%	0.0 – 0.02
Chelating Agents/Stabilizers	EDTA, Pentaerythrityl tetra-di-t-butyl hydroxyhydrocinnamate	0	0-1%	0



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Reformulated Toothpaste to minimize 1,4-Dioxane content

BASF NY Compliant Formula			Total 1,4-dioxane	0.01 - 0.09
Ingredient Type	**BASF Product**	**Typical 1,4 dioxane level (ppm)**	**Typical Use Levels**	**1,4-Dioxane in the bottle (ppm)**
Abrasives	Hydrated silica, alumina, calcium carbonate	0	10-50%	0
Binders/Rheology Modifiers	**Pluracare E 400 NF PEG FLEX + Pluracare E 600 NF PEG FLEX** (PEGs)	1	0.5-7%	0.01 – 0.07
Humectant	Sorbitol, Glycerin	0	20-60%	0
Surfactant	**Pluracare F 127 NF PR FLEX** (poloxamer)	1	0.3-2%	0.00 – 0.02
Colorant	Dyes, Effect pigments	0	0.1-1.5%	0
Flavors	Menthol, peppermint, spearmint, green tea, sodium saccharin	0	0.5-2%	0
Actives	Bisabolol, Panthenol, Vitamins, Bioactives	0	0-1%	0
Fluoride	Sodium Fluoride, MFP, Stannous Fluoride	0	0-0.25%	0
Preservatives/ Sweetener	Sodium Benzoate, Saccharin,Stevia	0	0-1.0%	0

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What's next?

Today's take-aways and how we can help.

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Summary

1,4-Dioxane regulation is on the horizon and must be continuously monitored for any changes

Formulators will need to navigate the changing landscape and reassess their ingredient choices

Harness the expertise of BASF to navigate regulation and reformulate for continued success

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Questions?

Seth Erdner

Business Director, Home Care and I&I

Jeffrey Brown

Regulatory Specialist

Stephanie Webb

Director of Product Management and Standard Surfactants

Farheen Qadir

Business Director, Personal Care

- **Webinar will be recorded and circulated along with pdf of this presentation**
- **Additional questions can be emailed to CareChemicalsNA@basf.com**

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