

Acetals as degreaser

Short overview of the range

Acetals

CLP

CLASSIFICATION & LABELLING

Classification

Acetal	Boiling point (°C)	Flash Point (°C)	Hazard pictograms	Hazard statements
Methylal	42.3	-30,5		H225 - Highly flammable liquid and vapour
Ethylal	88	-7		H225 - Highly flammable liquid and vapour
Propylal	137,4	26		H226 - Flammable liquid and vapour
Butylal	182,5	62,2	None	
TOU	201,5	88	None	
2-ethylhexylal	290	142	None	
1,3-Dioxolane	76	<= 2,5	 	H225 - Highly flammable liquid and vapour H319 - Causes serious eye irritation

General Characteristics

- Low Toxicity

- No pictogram



- Low Eco-Toxicity

- No pictogram



➤ Safe for human health and environment

- VOC

2-ethylhexylal is not a VOC according to the European general VOC definition.

- Bio-sourced Acetals or potentially

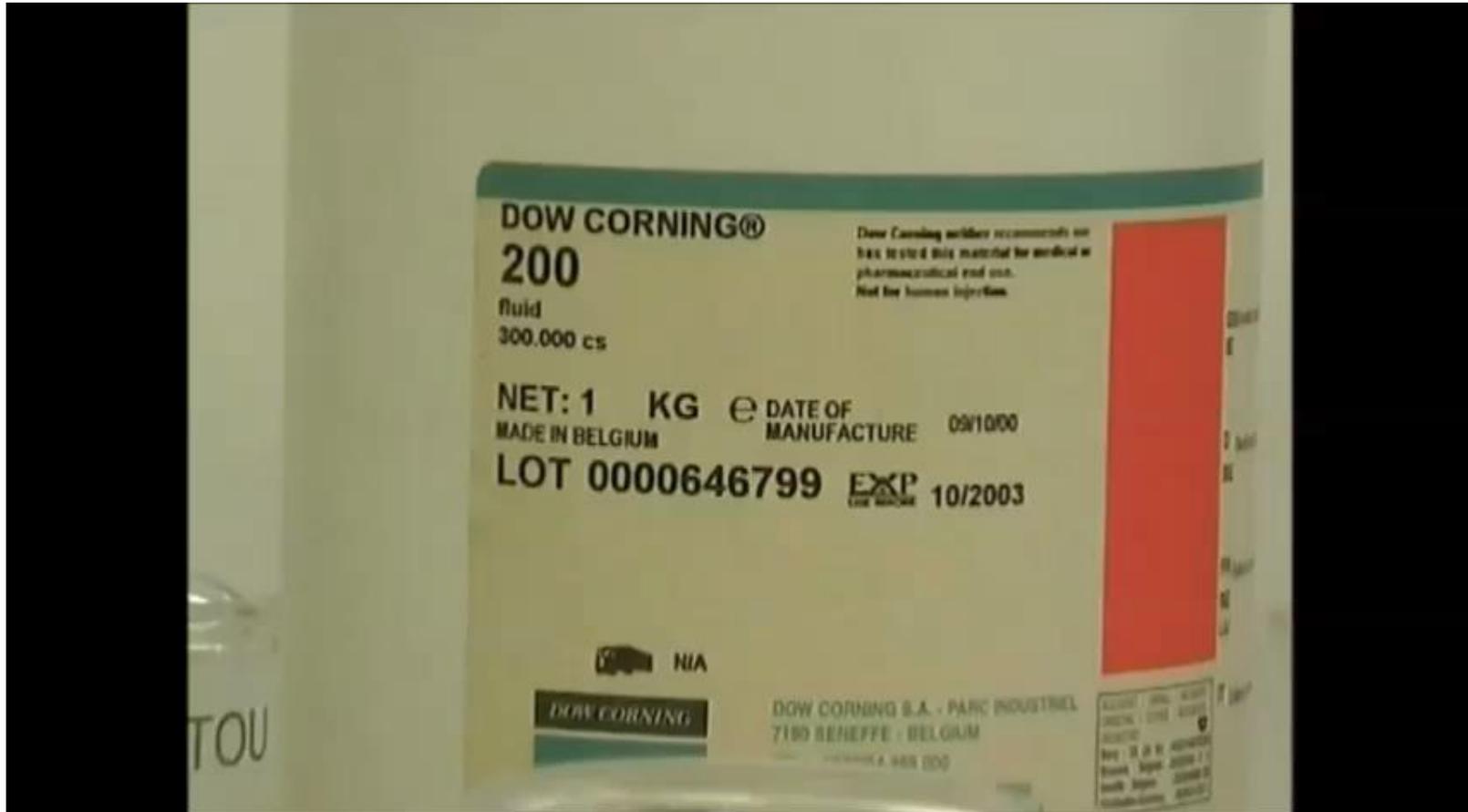
- Ethylal (> 85%)

Some lab trials

COMPATIBILITY WITH SILICONE AND GREASE

Solubility

PDMS 300 000 cst



Solubility

Lithium complex grease (Mineral oil based)



Degreasing ability

Acetals	Silicone	Grease	
Methylal	✓✓✓	✓✓✓	Fast
Ethylal	✓✓✓	✓✓✓	
Propylal	✓✓	✓✓	
Butylal	✓✓	✓✓	
2-ethylalhexylal	✓	✓	Very slow
TOU	X	X	
Dioxolane	X	X	



Which acetal at a glance

	Methylal	Butylal	Dioxolane	TOU
CLP		/	 	/
Solvent power	High	Good	High	high
Water miscibility	Partial	None	Total	Total
Evaporation	Extremely fast	Slow	Fast	Very slow
Polarity	Low	Very low	High	High
Surface tension	Very low	Low	Medium	Medium
What for	Mainly under spray form: - Cleaning - Degreasing	- Degreasing - Cleaning (rubber, sealant, bitumen..)	- Cleaning (fast evaporation)	- Cleaning (not hazardous)

FOCUS ON BUTYLAL

CLP – Not classified

Substance type : Mono-constituent
Chemical name : Dibutoxymethane
CAS N° : 2568-90-3
EC N° : 219-909-0

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Dibutoxymethane (Main constituent)	(CAS N°) 2568-90-3 (EC N°) 219-909-0 (REACH-no) 01-2119973500-41-0000	≥ 99	Not classified
Water (Impurities)	(CAS N°) 7732-18-5 (EC N°) 231-791-2	< 0,25	Not classified

Environmental info

Biodegradation in water: screening tests

Determination of Biodegradability of butylal in the Manometric Respirometry Test (according to Annex of EEC-Directive 92/69; corresponds to OECD Guideline 301 F and ISO Standard 9408) shows:

- Biodegradation degree (BOD of ThOD) after 28 days : 30 - 40 %
- Biodegradation degree (BOD of ThOD) after 34 days : 40 - 50 %
- The test substance is in this test partly or moderately biodegradable and not readily biodegradable (according to OECD criteria)

Biodegradation in water and sediment: simulation tests

The results obtained from the preliminary experiments suggest that butylal or a rapidly formed degradation product volatilised from the natural waters after short incubation periods. Based on the preliminary results, it is considered that the main experiment was not feasible.

- It is not feasible to conduct the full OECD 309 study as the test item did not remain in the natural water test system for sufficient time to allow mineralisation to carbon dioxide to take place. Therefore the identification of the degradation products of the test item in the conditions of the OECD 309 is not feasible.

Biodegradation in soil

The mobility of butylal in soil is medium ($150 < K_{oc} < 500$, McCall & Helling's classification) with K_{oc} of 184.1 L/kg, meaning that butylal has not a high potential for adsorption to soil.

(nov 2020)

Butylal

WATER BASED FORMULATIONS

Macro/Micro Emulsions

Reference	Emulsion	Butylal	Water	Surfactant	
CL 1	Macro	30%	61%	3,6 %Mulsifan K 326 Spezial 3,6% Mulsifan RT 410 G 1,8% Mulsifan RT 113	
CL3	Micro	60 %	15 %	18% Mulsifan K 326 Spezial	
CL4	Micro – jelly	60 %	15 %	18% Montanox 80	<p>When shaken, it becomes like a gel</p> 

CL

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PRODUCT SHEET

**Emulsion 30% Butylal Based
With Z&S surfactant****Introduction**

Formulation issued from Guideline formulation CT 09-05-03 from Zschimmer & Schwarz.
This formulation developed by Zschimmer & Schwarz, can be used in many applications for of heavy-duty cleaner (remove grease, bitumen...).

The final mixture is a milky liquid.
Stable 2 months at temperature between 3°C to 40°C.

Advantages of Acetals

Butylal: hydrophobic solvent usable for removing greases, bitumen...

Composition

Commercial Name	%	Function	Ingredient	Supplier
Butylal	30.00	Solvent	1-(butoxymethoxy)butane	Lambiotte & Cie
Mulsifan RT 410 G	3.60	Surfactant	Combination of fatty alcohol polyalkylene glycol ether and fatty acid ester	Zschimmer & Schwarz
Mulsifan RT 113	3.60	Surfactant	Fatty acid polyglycol ester	Zschimmer & Schwarz
Mulsifan K 326 Spezial (HLB : 10)	1.80	Surfactant	Combination of anionic and non-ionic surfactant	Zschimmer & Schwarz
Water	61.00	Solvent	/	/
Total	100			

Manufacture

- Mix the Butylal with Zschimmer & Schwarz surfactant.
- While a high stirring (with Ultra Turax) during 2 min, add water
- Homogenise until getting a milky solution.

Application

- Place in a dip bath engine.
- Wait from few minutes to few hours. (depending on dirties, surface...)
- Rinse with water or wipe it out

PRODUCT SHEET
Microemulsion 60% Butylal Based
With Z&S surfactant

Introduction

Formulation issued from Guideline formulation from Zschimmer & Schwarz.

A micro-emulsion is a quaternary system obtained from a mixture of four different types of ingredients:

- aqueous phase
- oil phase
- surfactant: ionic surfactants

The final mixture is a transparent and isotropic liquid.

Application: heavy-duty detergent (remove grease, bitumen...)

Advantages of Acetals

Butylal: hydrophobic solvent usable for removing greases, bitumen...

Composition

Commercial Name	%	Function	Ingredient	Supplier
Butylal	60.00	Solvent	1-(butoxymethoxy)butane	Lambiotte & Cie
n-butyl Alcohol	7.00	Solvent	n-butyl Alcohol	Distributor
Mulsifan K 326 Spezial (HLB : 10)	18.00	Surfactant	Combination of anionic and non-ionic surfactant	Zschimmer & Schwarz
Water	15.00	Solvent	/	/
Total	100			

Manufacture

- Mix the both organic solvents together and the surfactant (Butylal, Butyl Alcohol Oleic acid, and Mulsifan K 326).
- Add water: solution becomes slightly white emulsion (in contact between organic phase).
- Homogenise until getting a clear solution.

Application

- Place in a dip bath engine.
- Wait from few minutes to few hours. (depending on dirties, surface ...)
- Rinse with water or wipe with a cloth.

CL

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PRODUCT SHEET**Microemulsion 60% Butylal Based
With Montanox 80****Introduction**

A micro-emulsion is a quaternary system obtained from a mixture of four different types of ingredients:

- aqueous phase
- oil phase
- surfactant: ionic surfactants

The final mixture is a transparent and isotropic liquid.

Application: Heavy Duty detergent (remove grease, bitumen, adhesives...).
Can be apply with a brush.

Aspect: Viscous solution.
The solution is a viscous liquid able to become a gel under agitation.

Advantages of Acetals

Butylal: hydrophobic solvent usable for removing greases, bitumen, adhesives...

Composition

Commercial Name	%	Function	Ingredient	Supplier
Butylal	60.00	Solvent	1-(butoxymethoxy)butane	Lambiotte & Cie
n-butyl Alcohol	7.00	Solvent	n-butyl Alcohol	Distributor
Montanox 80 (HLB : 15)	18.00	Surfactant	Polysorbate 80	Seppic
Water	15.00	Solvent	/	/
Total	100			

Manufacture

- Mix the both organic solvents together and the surfactant (Butylal, Butyl Alcohol and Montanox 80).
- Add water: solution becomes slightly white emulsion (in contact between organic phase).
- Homogenise until getting a clear gel.

Application

This cleaner can be used in various ways: liquid, sprayed or dipping bath.

Compatibility, solubility, degreasing effect with various type of hydrophobic products (petroleum jelly , silicone oil, greases)

EXPERIMENTAL TESTING

Butylal - degreaser

- Grease/lubricant applied in excess on the surface of the substrate
- Part of the substrate is dipped into a beaker filled with **Butylal**:
 - Static or dynamic conditions (stirring)
 - Room temperature
 - 10-15 or 30 minutes
 - Dipped part air-dried only, no paper/cloth wiping
- Comparison before/after dipping:
 - Aspect/appearance of the treated part of the substrate
 - Water droplet test:
 - Higher angle of contact (bead shape): surface more hydrophobic
 - Lower angle of contact (flat shape): surface more hydrophilic

Petroleum jelly degreasing

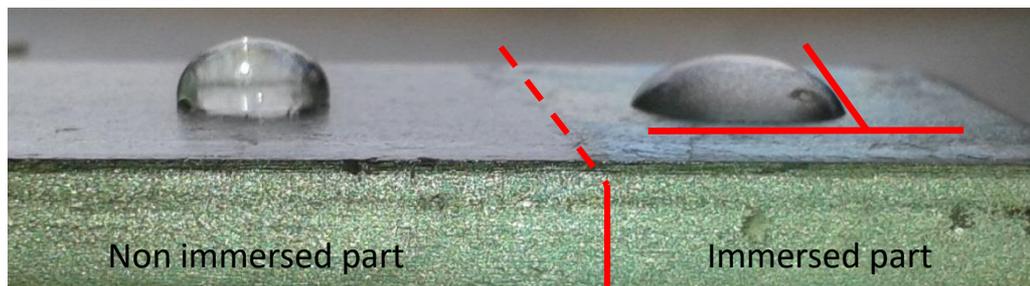
- **Thin** layer applied on the surface
- Dynamic immersion (stirring)
- 10-15 minutes
- Room temperature



-
- **Before dipping**
 - **Water droplet contact angle > 90°**
 - **More hydrophobic surface**
-



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- **After dipping**
 - **Water droplet contact angle < 90°**
 - **More hydrophilic surface**
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Lithium/calcium grease degreasing

- Static immersion
- 30 minutes
- Room temperature

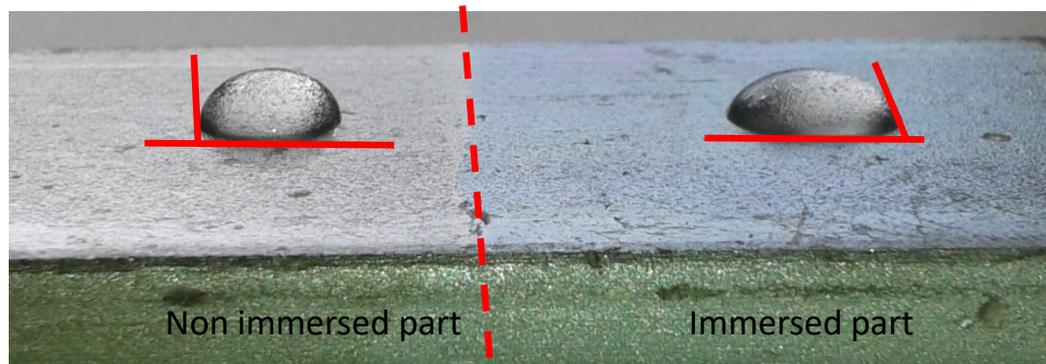


- Water droplet contact angle > 90
- Surface more hydrophobic

- Water droplet contact angle < 90
- Surface more hydrophilic

Silicone oil degreasing

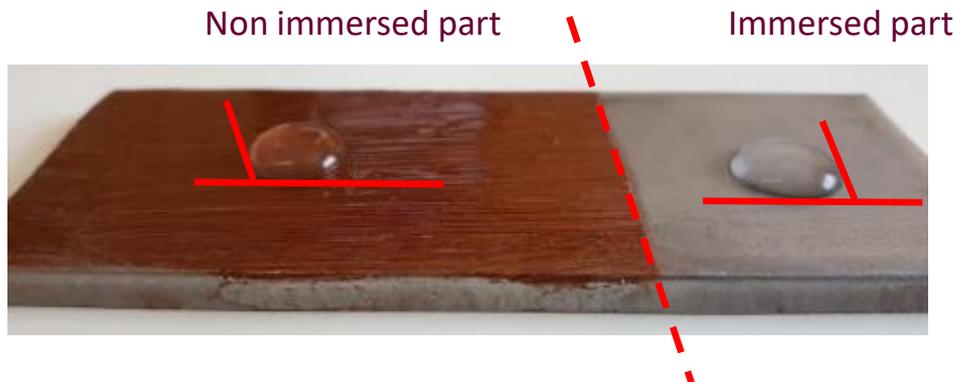
- Static immersion
- 10-15 minutes
- Room temperature



- **Water droplet contact angle > 90**
- **Surface more hydrophobic**

- **Water droplet contact angle < 90**
- **Surface more hydrophilic**

Copper grease degreasing



Water droplet contact angle $> 90^\circ$
Surface more hydrophobic

Water droplet contact angle $< 90^\circ$
Surface more hydrophilic

- Dynamic immersion (stirring)
- 10-15 minutes
- Room temperature

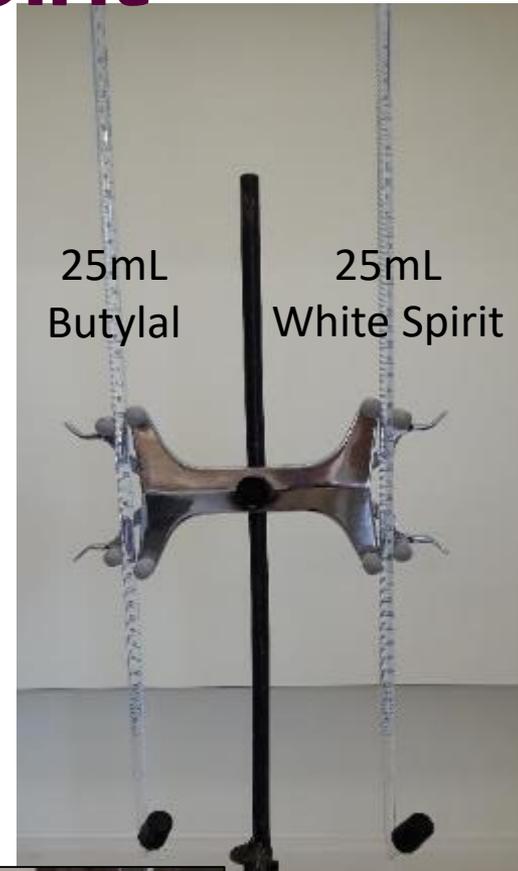
Comparison with White spirit and Terpene

EXPERIMENTAL TESTING

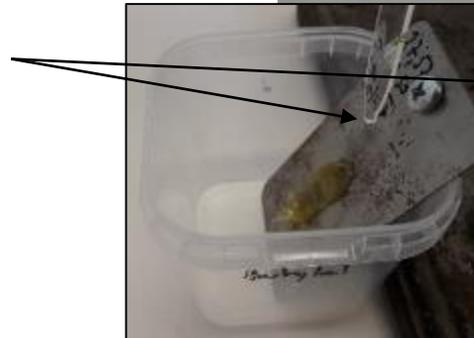
Butylal vs White Spirit



0,50g grease
T = 0



Drop by drop flow
+/- 0,2mL/min



Butylal vs White Spirit



T = 1h49
V = 21,5mL



Butylal vs White Spirit

Butylal



0,49g grease (98%)
removed

White Spirit



0,26g grease (52%)
removed

T = 2h33
V = 25mL

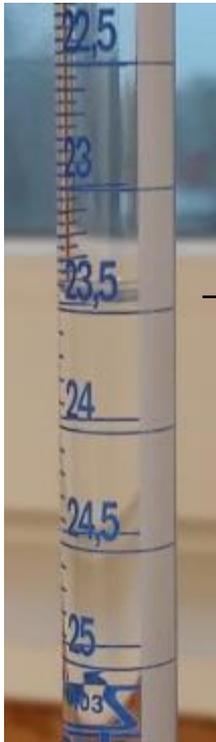
Butylal vs Orange Terpenes



0,50g grease
T = 0



Butylal vs Orange Terpenes



0,50g grease (100%)
removed



0,25g grease (50%)
removed

Conclusion

Butylal is an efficient degreaser:

- ✓ Can solubilize different types of grease/lubricant
- ✓ Thin or thick layer
- ✓ Static or dynamic conditions
- ✓ At room temperature
- ✓ Time efficiency

Bitumen remover

EXPERIMENTAL TESTING

Which sectors?



Bitumen removal

Buret test

- Drop by drop flow
- Buret containing 25 mL of
 - White spirit
 - Isopar M
 - Butylal
 - Propylal
- Cement klinker with one week dried bitumen layer



Bitumen removal

Buret test



White spirit	Butylal	Isopar M	Propylal
	-		

Butylal has an efficiency similar to white spirit without any labeling (under CLP)

Bitumen removal

Butylal micro-emulsion

Continuous flow

- Fountain with continuous flow of Butylal (pump system)
- Use of Butylal and micro-emulsion containing Butylal
- Cement klinker with one week dried bitumen layer

Phases	Ingredients	% weight
	Demin. water (1)	15
	n-Butanol (2)	7
	Butylal (3)	60
	MULSIFAN K 326 SPEZIAL (4)	15
	Oleic acid, technical grade (5)	3
	TOTAL	100.00

Bitumen removal

Butylal micro-emulsion

Continuous flow



Bitumen removal

Butylal micro-emulsion

Continuous flow



30 sec



1 min 30 s



4 min

Bitumen removal

Butylal macro-emulsion

- Immersion during approximately 30 minutes in the macroemulsion following by a rinsing using a pipet
- Cement klinker with one week dried bitumen layer

Ingredients:

Chemical characterisation:

Butylal ¹⁾		30.0 %
MULSIFAN RT 410 G	Fatty alcohol poly alkylenglycol ether / Fatty acid ester	3.6 %
MULSIFAN RT 113	Fatty acid polyglycol ester	3.6 %
MULSIFAN K 326	Blend of anionic and nonionic surfactants	1.8 %
Water		61.0 %

Bitumen removal

Butylal macro-emulsion



To sum up

- Butylal is very efficient to remove any bitumen-based material
- Solvent and water-based formulations (emulsions)
- Biodegradable at
 - 30 - 40 % after 28 days
 - 40 - 50 % after 34 days
- Non-labeled under CLP

Butylal vs d-limonene - CLP

	Limonene	Butylal
Toxicity	Skin irritation Cat. 2 Skin sensitisation Cat. 1 Aspiration Toxicity Cat. 1 Acute aquatic toxicity Cat. 1 Chronic aquatic toxicity Cat. 1 	None
Flammability	Flammable liquid Cat. 3	Not
Water miscibility	Not	Not
Boiling Point	~ 176	180.5
Kauri Butanol	~ 67	~ 70

Terpene (d-limonene)  Butylal

INDUSTRIAL

TEXTILE : DRY/WET CLEANING

DRY/WET CLEANING

	Perchloroethylene	Limonene	Butylal
Toxicity	Carcinogenicity Cat. 2 Chronic aquatic toxicity Cat. 2 	Skin irritation Cat. 2 Skin sensitisation Cat. 1 Aspiration Toxicity Cat. 1 Acute aquatic toxicity Cat. 1 Chronic aquatic toxicity Cat. 1 	None
Flammability	Not	Flammable liquid Cat. 3	Not
Water miscibility	Not	Not	Not
Boiling Point	~ 121	~ 176	180.5
Kauri Butanol	~ 90	~ 67	~ 70

DRY/WET CLEANING

Butylal replaces

- Perchloroethylene in dry cleaning
- Terpenes in wet cleaning

Benefits:

- Excellent cleaning performance – effective against lipophilic AND hydrophilic soil
- Easy finish and pleasant feel
- Halogen free
- Tested dermatologically with the result “Very Good”
- Safe cleaning process
- Environmentally friendly
- The process occurs under vacuum

Product on the market :

Dry cleaning (Butylal)

2 Composition/information on ingredients

- Chemical characterization: Substances
- CAS No. Description
2568-90-3 1,1'-[methylenebis(oxy)]dibutane
- Identification number(s)
- EC number: 219-909-0
- Description: Halogen-free solvent for dry cleaning in SYSTEMK4 (patent pending)



Product on the market : Laundry (Butylal)

Dispose d'un pouvoir dégraissant puissant sur les graisses et huiles animales et végétales.

Convient pour le linge de restaurant, vêtement de travail de l'industrie alimentaire, linge de corps, etc.

Neutralise les odeurs résiduelles désagréables et laisse une agréable odeur d'agrumes sur le linge traité

ainsi que dans toute la blanchisserie. S'utilise manuellement ou en système de dosage automatique.



Nom	Identificateur de produit	%	Classification se règlement (CE) N [CLP]
Alcool éthoxylé	(Numéro * CAS) 68213-23-0 (N° REACH) exemption polymer	10 - 25	Acute Tox. 4 (Oral), Eye Dam. 1, H318 Aquatic Chronic 3, H
Alcool éthoxylé 3OE	(Numéro * CAS) 157627-86-6 (N° REACH) exemption polymer	15 - 25	Eye Dam. 1, H318 Aquatic Acute 1, H411 Aquatic Chronic 3, H
Ether Méthylque du Dipropylnéglycol substance possédant des valeurs limites d'exposition professionnelle communautaires substance possédant unedes valeurs limites d'exposition professionnelle nationales (FR)	(Numéro * CAS) 34590-94-8;34590-94-8 (Einesc nr) 252-104-2 (N° REACH) 01-2119450011-60	5 - 10	Non classé
Propan-2-ol	(Numéro * CAS) 67-63-0 (Einesc nr) 200-661-7 (EG annex nr) 603-117-00-0 (N° REACH) 01-2119457558-25	5 - 10	Flam. Liq. 2, H225 Eye Irrit. 2, H319 STOT SE 3, H336
Butylal ←	(Numéro * CAS) 2568-90-3 (Einesc nr) 219-909-0 (N° REACH) 01-2119973500-41	< 5	

INDUSTRIAL

METAL DEGREASER

Heavy duty metal degreasing

	Trichloroethylene	Perchloroethylene
Toxicity	<p>Carcinogenicity Cat. 1B Germ cell mutagenicity Cat. 2 Eye irritation Cat. 2 Skin irritation Cat. 2 Specific target organ toxicity - single exposure Cat. 3 Chronic aquatic toxicity Cat. 3</p> 	<p>Carcinogenicity Cat. 2 Chronic aquatic toxicity Cat. 2</p> 
Flammability	Not	Not
Water miscibility	Not	Not
Kauri Butanol	~ 129	~ 90
Evaporation rate (BuAc)	6,4	2,6

Heavy duty metal degreasing simulation

- Standard reference steel sample : superficial carbon content of 65,2 mg/m²
- Samples dipped in an ultrasound tank
 - 1 or 10 minutes
- Rinsed with the same solvent
- Dried a few minutes by air
- Wrapped in an aluminium sheet
- Placed under vacuum before analysis

Heavy duty metal degreasing

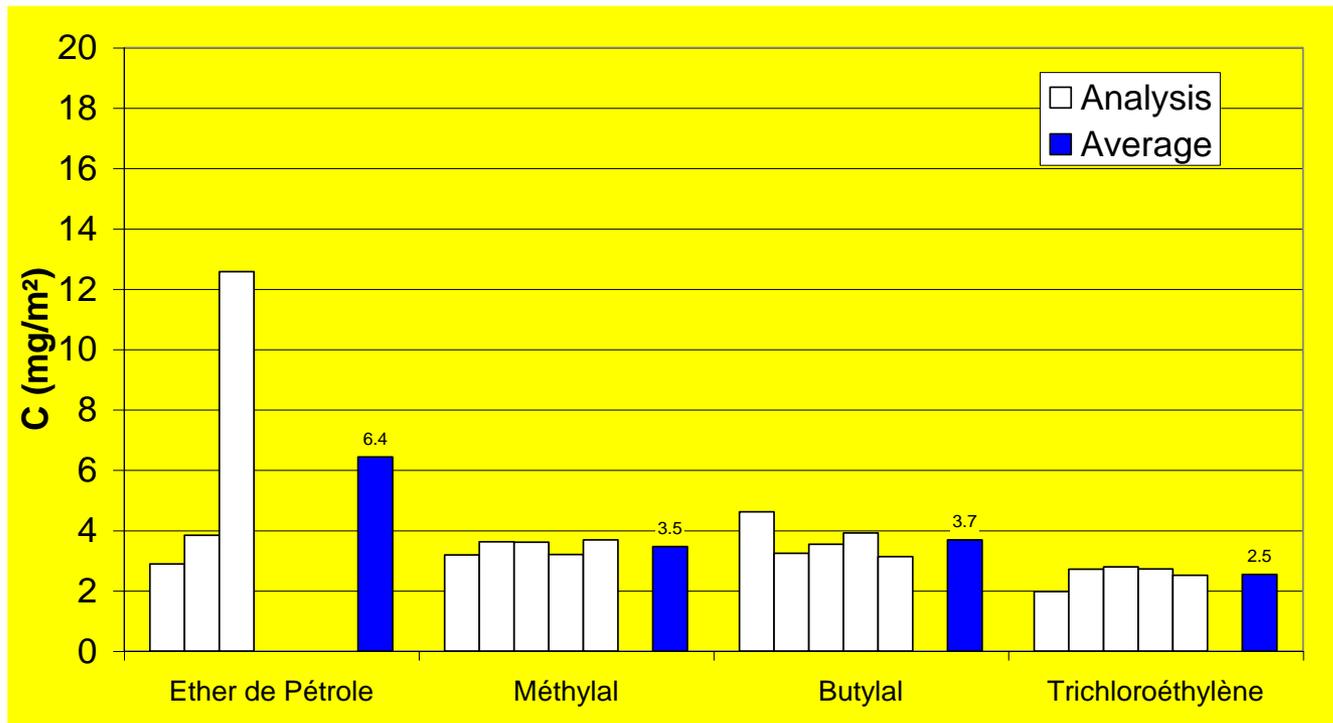
Sample Nr	Solution	Treatment	C mg/m ²
R	Standard		65.2
E1	Hydrocarbon	1 min	6.4
E2	Hydrocarbon	10 min	3.5
M1	Methylal	1 min	3.5
M2	Methylal	10 min	2.6
B1	Butylal	1 min	3.7
B2	Butylal	10 min	2.3
T1	Trichloroethylene	1min	2.5
T2	Trichloroethylene	10 min	2.0

👉 Butylal and Trichloroethylene have same efficiency.

Steel degreasing

- Comparison of solvents degreasing

→ 1 minute, in ultrasonic bath



Steel degreasing

- Comparison of solvents degreasing

→ 10 minutes, in ultrasonic bath

