

L A M B I O T T E & C I E S . A .



Acetals

Acetals in Cleaning

Lambiotte
&Cie



LAMBIOTTE & CIE

Lambiotte & Cie. started its activities in 1860 with forestry and sawmill exploitation, producing railway sleepers. In a desire to increase the value of its wood waste production, the company adopted an innovative carbonization process to convert wood to charcoal. One of the chemical by-products of this distillation technology was methanol. From 1901, Lambiotte's interest in chemicals grew with the production of formaldehyde from wood methanol. By 1970, Lambiotte's passion for chemistry led to the use of formaldehyde as a reagent in the production of acetals and hemicetals. Since then, the company has continued to develop its expertise in production technologies, making it a leader in the highly specialised field of acetals synthesis.

We at Lambiotte are proud to offer a wide range of industrial acetals, manufactured with state-of-the-art equipment in a continuous process reaction. Our precision and technical expertise in this specialist field guarantees the highest and most constant quality and purity of product, allowing us to respond to each specific demand for synthesis of acetals and chemical derivatives from aldehydes and/or alcohols.

A dedicated support team is available to give the customer technical advice, providing tailored formulae for many industrial sectors. In order to meet the customer's needs, we propose the services of our application laboratories in aerosols, cosmetics, coatings...to develop customised formulae. Indeed, every department in Lambiotte, be it production, quality control, sales, marketing, logistics or accounting is dedicated to customer satisfaction. A world-wide network of specialised distributors ensures fast product availability, delivery, and technical support to guarantee optimal client services.

DETERGENCY IN A FEW WORDS

Detergents are substances or preparations containing, among other ingredients, soaps or other surfactants intended for water-based laundry or dishwashing processes. Detergents may be of any form (liquid, powder, paste, bar, cake, moulded piece, shaped, etc.) and be used for household, institutional or industrial purposes. The function of detergents is to wash or clean laundry, fabrics, dishes or kitchen utensils, as well as hard surfaces.

A detergent is a combination of various ingredients for a specific function, depending on the purpose to be achieved, the material to be cleaned, the properties of the water, and so on. A detergent formulation may also differ from one region to another depending on the washing habits of the population.

In this trend of environmental friendly products, Lambiotte's acetals found inevitably their place in this field of activity. Their high solvent and degreasing power, quick drying time and compatibility with surfactants are some of their decisive advantages.



ACETALS IN CLEANING

Methylal, Ethylal, Butylal, Dioxolane and Glycerol Formal belong to the acetals' family.

THEIR PHYSICAL AND CHEMICAL CHARACTERISTICS GIVE EXTRAORDINARY BENEFITS FOR CLEANING:

- I. Better cleaning properties
- II. High solvent power
- III. Water miscibility
- IV. Good degreasing properties
- V. Quicker drying time
- VI. Compatibility with organic solvents and surfactants

ACETALS FIND APPLICATIONS IN THE FOLLOWING CLEANING EXAMPLES:

- Personal care
 - ⇒ Hand cleaner
 - ⇒ Nail varnish remover
- Household
 - ⇒ Spot Remover
 - ⇒ Bathroom cleaner
 - ⇒ Kitchen cleaner
 - ⇒ Window cleaner
 - ⇒ Carpet cleaner
 - ⇒ Heavy duty cleaner
- Technical
 - ⇒ Paint Stripper
 - ⇒ Graffiti Cleaner
 - ⇒ Adhesive/Silicone remover
 - ⇒ Bitumen remover
- Automotive
 - ⇒ Brake cleaner
 - ⇒ Rim cleaner
 - ⇒ Engine cleaner
- Industrial
 - ⇒ Metal degreaser
 - ⇒ PU cleaner
 - ⇒ Detergency
 - ⇒ Blanket wash

ADVANTAGES

I. BETTER CLEANING PROPERTIES

Thanks to a low surface tension and a low viscosity, Methylal and Ethylal are interesting products to improve the penetration of the products and the surface covering during application.

Acetals	Surface Tension (mN/m) (25°C)
Methylal	21.20
Ethylal	21.62
Butylal	25.20
1,3-Dioxolane	34.30
Glycerol Formal	44.49

Ethylal reduces the surface tension of water more than ethanol.

Moreover, Ethylal reduces the surface tension of water more than Methylal.

5% of Ethylal in water reduce the surface tension of water as much as 20% of Methylal.

Water	Composition			Surface Tension (mN/m) (25°C)
	Methylal	Ethylal	Ethanol	
100	/	/	/	72.26
95	/	5	/	36.40
	5	/	/	50.68
90	10	/	/	43.45
	/	/	10	46.79
80	20	/	/	34.16
	/	/	20	37.43

Acetals, thanks to their low viscosity, are interesting products to improve cleaning efficiency.

Solvents	Kinematic viscosity (10 ⁻⁷ m ² /s) 25°C
Methylal	3.71
Ethylal	5.07
Butylal	10.83
1,3-Dioxolane	5.53
Glycerol Formal	117
IPA	26.5

II. HIGH SOLVENT POWER

Dioxolane is the most powerful solvent of our range.

With a Kauri Butanol index value higher than 200, this one is a very efficient solvent for cleaning applications.

Dioxolane is the ultimate solvent to overcome heavy solubilisation problems.

Comparison of Kauri-Butanol values	
Acetals	Other Solvents
Methylal: 164 Ethylal: 120 Butylal: 75 Dioxolane: > 207 Glycerol Formal: 74	Methylene chloride: 115
	NMP: > 200
	Toluene: 105
	Xylene: 90
	Heptane: 32
	n-Pentane: 27
	Isoparaffins: ~ 28
Dearomatized: ~ 30	
DBE: 50-55	
d-Limonene: ~ 70	

III. WATER MISCIBILITY

Linear acetals, such as Methylal, Ethylal and Butylal, are partially water soluble.

The longer the carbon chain of the acetal the less the water miscibility.

Cyclic acetals, such as Dioxolane and Glycerol Formal, are fully water soluble.

Acetals	Solubility of acetal in water (% weight)	Solubility of water in acetal (% weight)
Methylal	32.3	4
Ethylal	6.33	1.21
Butylal	Not miscible	0.24
Dioxolane	Fully miscible	Fully miscible
Glycerol Formal	Fully miscible	Fully miscible



ADVANTAGES

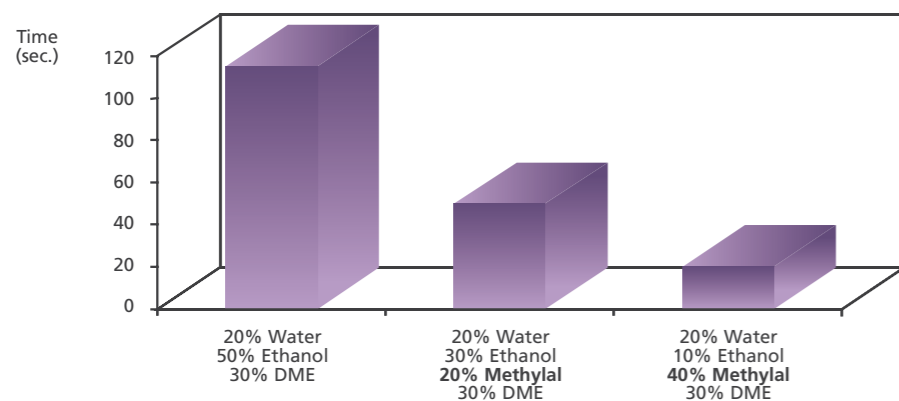
IV. DEGREASING PROPERTIES

Methylal, Ethylal and Butylal are excellent degreasers. According to the drying time you are looking for, choose one or another: Methylal faster drying, Butylal slower drying.

V. SHORTER DRYING TIME

Methylal shortens the drying time. This reduction of the drying time is much more obvious with water-based aerosol formulations with DME (low VOC). The drying time of a solvent/propellant blend sprayed on paper is dramatically reduced by the incorporation of Methylal. Generally speaking, Methylal improves the drying time of a mix of solvents.

Influence of Methylal on the drying time



VI. COMPATIBILITY WITH SOLVENTS/SURFACTANTS.

Acetals have the advantage to be used in synergy with most of organic solvents. Moreover, acetals are compatible with surfactants.



APPLICATIONS

PERSONAL CARE

Acetals also find applications in cosmetics.

Indeed, Methylal, Dioxolane and Butylal (dibutoxymethane) are INCI and offer a wide range of possibilities.

Acetals have the advantage to be less irritating than lots of ingredients.

HAND CLEANER

Hand cleaning gel		
Ingredients	INCI	% weight
Deionized Water	Aqua	48.90
Methylal	Methylal	35.00
Ethanol	Alcohol	15.00
AMP	Aminomethyl propanol	0.30
Ultrez 10	Carbomer	0.30
Perfume	Fragrance	0.50

Thanks to its high degreasing power, Butylal allows to formulate hand cleansing gel. Even for heavy duty cleaning, such as garage soap.

Hand cleansing cream		
Ingredients	INCI	% weight
Rapeseed Oil	Brassica Campestris (Rapeseed) Seed Oil	35.0
Butylal	Dibutoxymethane	20.0
OXYPON 401	PEG-9 Cocoglycerides	1.0
Antioxidan		q.s
Carbopol Ultrez 21	Acrylates/C10-30 Alkyl Acrylate Crosspolymer	0.6
ZUSOLAT 1005/85	Deceth-5	5.0
ZETESOL NL-2	Sodium Laureth Sulfate	26
AMPHOTENSID B 4 F	Cocamidopropyl Betaine	5.0
PROTELAN AGL 95	Sodium Lauroyl Glutamate	6.0
Perfume	Fragrance	q.s
Preservative		q.s
Water	Aqua	up to 100.0



APPLICATIONS

NAIL VARNISH REMOVER

Methylal is a good solvent, partially water soluble.

It is not irritating thus it does not damage the nail.

Its solvency and water miscibility allow to formulate with a high water content.

Methylal helps the penetration of the emollient into the skin and nail surface, preventing the classical drying effect.

Dioxolane is an excellent solvent, it removes easily nail varnishes. Dioxolane is also totally water miscible.

2 phases nail varnish remover				
Water, Methylal and Dioxolane based: efficient cleaner without irritation.				
Phase	Ingredient (INCI name)	%	Function	Brand Name
1	Water	27.9	Solvent	Water
	Dioxolane	10	Solvent	Dioxolane ultra pure
	Blue V	0.1	Colorant	90146 Blue V
2	Methylal	45	Solvent	Methylal pure
	Ethyl acetate	15	Solvent	Ethyl acetate
	Castor oil	1.5	Emollient	Castor oil
	Tocopheryl acetate	0.5	Moisturizer	Vitamine E acetate

HOUSEHOLD

In household applications, Methylal can substitute alcohol or IPA in many cleaning formulations with the advantages of:

- Better degreasing power
- Quicker drying

SPOT REMOVER

Methylal and Dioxolane are ideal solvents to substitute 1,1,1-trichloroethane and pentane.

Ingredients	% weight
Silica powder	3.50
Isopropyl alcohol	5.50
Pentane	19.00
Methylal	22.00
Propellant (propane/butane)	50.00

TECHNICAL

PAINT STRIPPER

Methylal and Dioxolane show an exceptional efficiency in stripping.

The combination of both products is similar to Methylene Chloride, but without the toxicity.

Used alone or together, they will enable you to formulate very efficient paint strippers for different paints such as:

- Alkydes
- Polyurethanes: 1 component (hygroscopic drying)
- Polyurethanes and epoxy: 2 components
- Vinylic and acrylic dispersions

The two standard paint strippers types (to scratch or rinseable) are easy to formulate with these solvents that are both miscible with water and presenting a low toxicity.

The solvent powers of Methylal and Dioxolane are exceptional, in terms of actions on polyurethane, epoxy and acrylic (including crosslinked) resins, and on the plasticisers used in paints.

Since they are small molecules, Methylal and Dioxolane, diffuse rapidly, and penetrate quickly the paint film.

The high vapor pressure of Methylal accelerates film removal, even at low temperatures.

The water miscibilities of Methylal and Dioxolane help to find appropriate strippers for paints such as latex, PVA (PolyVinyl Acetate) and interior paints.

GRAFFITI CLEANER

Methylal and Dioxolane are also good solvents to produce efficient and suitable formulations for a wide range of graffitis and surfaces.

The miscibility of Methylal (up to 33%) and Dioxolane (fully miscible) with water and other solvents allows to moderate the aggressivity of the products toward the painted surfaces.

Lambiotte has developed several formulations which are Methylal, Dioxolane and water based, adapted to the surface to clean.

APPLICATIONS

ADHESIVE / SILICONE REMOVER

Thanks to their good compatibility and solvent power with a wide range of adhesives and resins, acetals are suitable solvents to formulate adhesive as well as adhesive remover.

Adhesive type	Acetals	MeCl	DMF	THF	Dioxane	Aromatics	Chlorinated	Ketones
PVAC Polyvinyl acetate Ex. for wooden floor	→ Methylal	✓	✓	✓	✓	✓	✓	✓
PMMA PolyMethylMethAcrylate	→ Methylal → Dioxolane	✓	✓	✓	✓	✓		✓
PSF Polysulfone	→ Dioxolane	✓	✓	✓	✓			
SBR & SBS StyreneButadieneRubber StyreneButadieneStyrene	→ Methylal → Butylal → Dioxolane					✓		
ABS AcrylonitrilButadieneStyrene	→ Methylal → Dioxolane		✓	✓				
Natural latex	→ Butylal							

Because of its high Kauri Butanol index, Dioxolane is a good solvent for silicones. Its efficiency is especially noticeable as silicone remover.

AUTOMOTIVE

Methylal and Dioxolane are also widely used in automotive applications.

- Engine cleaner
- Carburettor cleaner
- Brake cleaner
- Rim cleaner
- Wax cleaner

For heavy duty cleaning, such as engine cleaning, Methylal can be combined with Dioxolane. Thanks to its high solvent power, Dioxolane can easily remove residues like burnt particles, rubber, silicones,...

Butylal is also an acetal that gives higher efficiency in cleaning and degreasing in the automotive industry. Moreover, Butylal is the ideal ingredient for heavy duty cleaning (bitumen removal for example). Butylal is the ideal substitute to terpene, such as limonene.



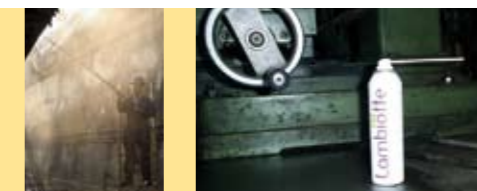
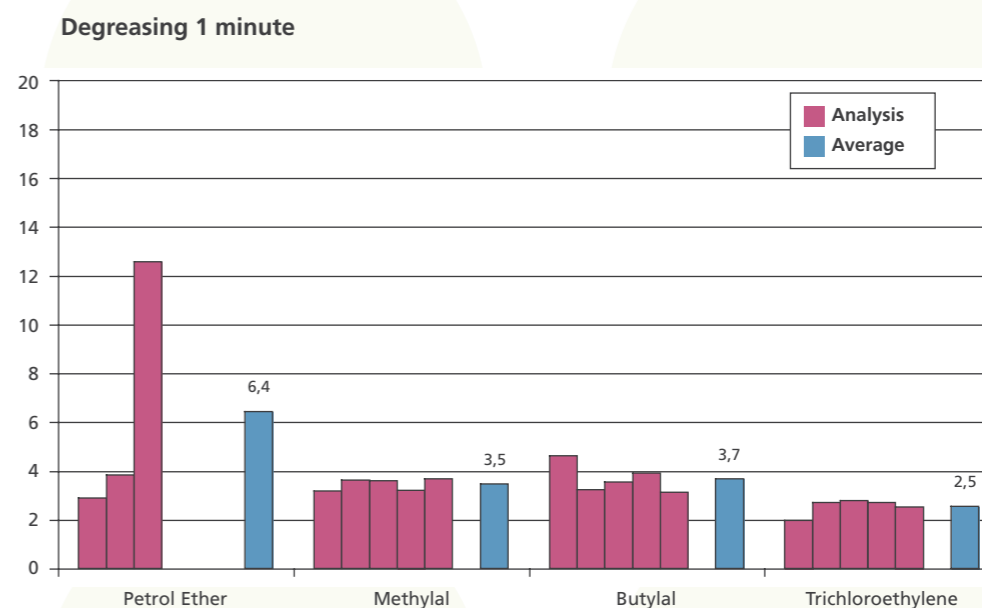
INDUSTRIAL

METAL DEGREASER

Acetals have a great interest in degreasing activities. Indeed, chlorinated solvents are nowadays labelled toxic for the trichloroethylene, nocive and toxic for aquatic organism for the perchloroethylene. In our environmental responsible society, those solvents have to be replaced by solvents with a good toxicological profile. Acetals thanks to their exceptional degreasing properties are the most suitable solution.

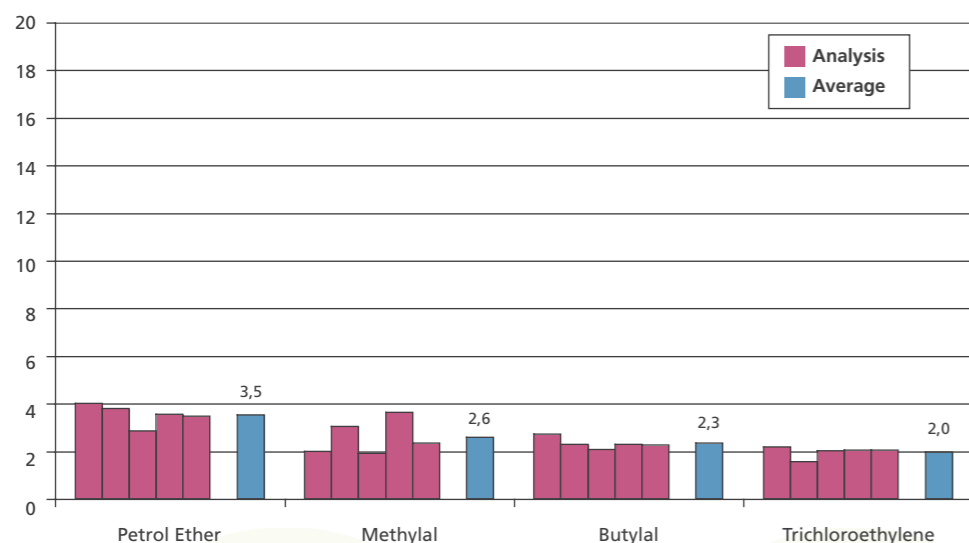
	Trichloroethylene	Perchloroethylene	Acetals	
			Linear	Cyclic
Toxicity	Carcinogenic Cat. 2 Mutagenic Cat. 3	Carcinogenic Cat.3 Toxic for aquatic organism	None	None
Flammability	Not	Not	Yes except Butylal	Yes except Glycerol Formal
Water miscibility	Not	Not	Partial	Complete
Kauri Butanol	~ 129	~ 90	Methylal: ~ 134	Dioxolane: >200
Evaporation rate (Ether)	6.4 (compared to BuAc)	8.1	Methylal: 1.5	Dioxolane: 0.27

Below, a study comparing the degreasing power of Trichloroethylene with Methylal and Butylal.



APPLICATIONS

Degreasing 10 minutes



Procedure:

- Samples of metal sheets are dipped in an ultrasound tank during 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

Results:

Sample Nr	Solution	Treatment	*C mg/m²
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	1 min	2.5
T2	Trichloroethylene	10 min	2.0

* C corresponds to the concentration in carbon (grease) at the surface of the metal.

As conclusion, the superficial carbon content of the metal is comparable with Butylal and Trichloroethylene.

Butylal and Trichloroethylene have the same efficiency.



PU CLEANER

Acetals are solvents of interest to use in the Polyurethane industry.

For example, Methylal is used as co-blowing agent.

In the cleaning field, Dioxolane is the most suitable solvent for mould and gun cleaning.

Material	Trademark	% weight change	Surface change
Polyurethane (PU)	Fabeltan 85C	>1000	Very soft gel

Conditions: 1 day immersion in Dioxolane at 25°C, samples 12 x 80 x 1,5mm

Thanks to its high solvent power, Dioxolane is the ideal solvent to remove PU residues in the PU industry.

DETERGENCY

Concerning industrial cleaning, the terpene family is well known and used.

However, orange terpene or d-limonene have now found an alternative. Butylal thanks to its high flash point and boiling point is a non labelled solvent. Moreover, its apple smell and high degreasing power are undeniable advantages in the detergency industry.

	Limonene	Butylal
Toxicity	Toxic for aquatic organism IARC: carcinogenic cat.3	None
Flammability	Yes R10	No
Water miscibility	Not	Not
Boiling Point	~ 176	180.5
Kauri Butanol value	~ 67	~ 70

BLANKET AND ROLLER WASH

It is often complicate to choose an optimal blanket and roller wash.
 With the emphasis on health, safety and environmental regulations, some concessions of desirable cleaning characteristics may be necessary in order to comply with regulations or safety standards.
 Drying time is often an important characteristic from the pressman's point of view.
 Regular blanket and roller wash solvents will dry slower and may leave a residue.
 Solvent strength is also an essential point. There is a compromise between strong and weak solvents.
 The recommended procedure is to use a medium strength product for routine repeated wash-ups and periodically use a stronger press wash or glaze remover and rubber conditioner. A one and only solvent can be used for both cleaning stages by decreasing its solvent power by diluting it with water.

Acetals offer a range of roller and blanket cleaner products available ranging in drying time, solvent strength and environmental and safety requirements.

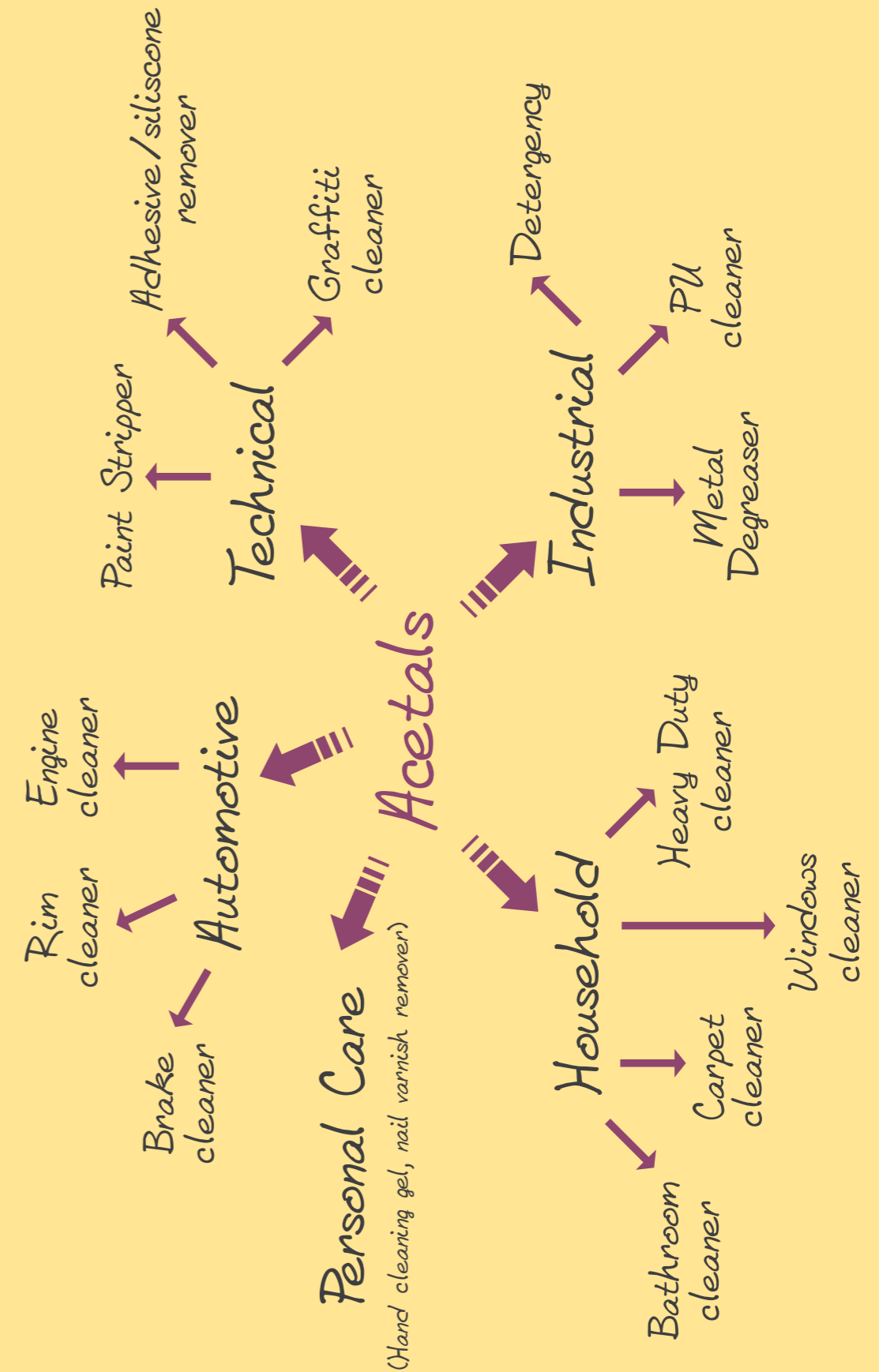
Dioxolane is recommended for blanket and roller wash. It is a really good cleaner, has a quick drying time, does not leave residues. It can be formulated with water for the routine wash and used pure for glaze removers and rubber rejuvenators.

Methylal is the ideal product if you are looking for a very fast drying time and good solvent strength.

Glycerol formal is more suggested for slow evaporating cleaning systems. It may be used on warm rollers. As it is not flammable, Glycerol formal is a safe product.

For people looking for emulsions, our proposal is Butylal.

An emulsifying solvent is very useful for the medium to large sheetfed or web printer since dual action cleaning can be achieved in one step. The solvent cut the ink while the water removes papers, gum and other water soluble materials from the blanket and rollers. The emulsion also helps suspend the ink and carry it away.



Lambiotte & Cie



OFFICES • BRUSSELS

Avenue des Aubépines 18
B-1180 Brussels
Belgium
Tel: +32 2 374 44 65
Fax: +32 2 375 31 55
E-mail: info@lambiotte.com
Web site: www.lambiotte.com

PLANT • MARBEHAN

Grand'Rue 79
B-6724 Marbehan
Belgium
Tel: +32 63 41 00 80
Fax: +32 63 41 16 98
E-mail: plant@lambiotte.com
Web site: www.lambiotte.com