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## Technical Information

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July 2005  
Supersedes issue dated May 2005

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# Luviset<sup>®</sup> P.U.R.

® = Registered trademark  
of BASF Aktiengesellschaft

**Hair setting polymer for Low VOC hair sprays**

## Cosmetic Solutions

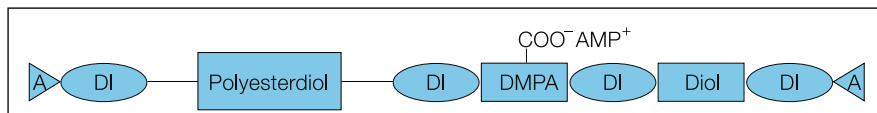
- Hair Care
- Skin Care
- Oral Care

**Description**

Luviset P.U.R. is a clear liquid with a possible faint blueish tint with a slight, characteristic odor. It is a hair-setting polymer that has been specially developed for use in hair sprays with a high water content (VOC 55 sprays). Conventional hair-setting polymers do not possess the properties required for these sprays. The unique character of this polymer gives additional cosmetic benefits such as flexibility.

**Composition**

Luviset P.U.R. consists of 30% polymer (polyurethane), 10% ethanol and 60% water. The polymer contains carboxyl groups that are 100% neutralized with AMP.



**DI:** Diisocyanate

**DMPA:** Dimethylol propionic acid

**A:** Quencher (Amine) Polyesterdiol: from isophthalic acid, adipic acid, hexanediol

**Diol:** aliphatic diol, like neopentylglycol

**INCI-name**

Polyurethane-1

**CAS-No.**

208054-84-6

**Physicochemical properties****Appearance**

Clear liquid with a possible faint blueish tint

Slight, characteristic

**Solubility**

Luviset P.U.R. is a neutralized anionic polymer. It forms solutions in water and ethanol/water mixtures at pH values of 8 or above. It precipitates in acid conditions.

**Polymer Compatibility**

Luviset P.U.R. is compatible with many other resins such as PVP, PVP/VA, Polyvinyl Caprolactam, Acrylates Copolymer, Acrylates/Acrylamide Copolymer, Octylacrylamide/Acrylates/Butylaminoethyl Methacrylate Copolymer, VA/Crotonates/Vinyl Neodecanoate Copolymer, Diglycol/CHDM/Isophthalates/SIP Copolymer, Acrylates/Hydroxyesters Acrylates Copolymer, PVP/Vinylcaprolactam/DMPA Acrylates Copolymer, Methacryloyl Ethyl Betaine/Acrylates Copolymer, AMP-Acrylates Copolymer or other commercially available polymers.

Depending on their degree of charge density, cationic polymers may be incompatible with Luviset PUR because of its anionic nature and mixtures of these are turbid and may even form a precipitate.

**Molecular weight**

approx. 10,000 –15,000 g/mol

Most conventional hair-setting polymers for water-free formulations have a much higher molecular weight than Luviset PUR, and combinations therefore give solutions with a much higher viscosity, which are more difficult to spray.

**Glass-transition temperature**

Because of the different components of the polymer, two different glass-transition temperatures are found at 55 to 60°C and – 6 to –10°C.

**Specification**

	Method	Specifications
Solids (%) (1 g/15 min/145°C)	MEM 02/0022	28.0 – 32.0
Ethanol (%)	MEM 02/0025	9.0 –11.0
pH value	MEM 02/0024	8.0 – 9.0
K-value (1% in NMP)	MEM 02/0023	35.0 – 39.0
Viscosity (mPas)	MEM 02/0026	100 – 400
Colour (Gardner)	MEM 02/0027	Max. 1.0
Isocyanates	MEM 02/0028	Not detectable

## Regulatory requirements

In the US, the CARB (California Air Resources Board) stipulates the maximum permissible content of VOCs in different consumer products (e. g. insect sprays, car cleaners, cosmetics) in the Clean Air Act Amendment.

The following values have been established for hair-styling products:

Hair sprays	max. 80% VOC (from 1 January 1993)	max. 55% VOC (from 1 January 1998 – now postponed to 1 June 1999)
Hair mousses	max. 16% VOC (from 1 January 1994)	
Hair gels	max. 6% VOC (from 1 January 1994)	

Other states in the USA have adopted similar regulations.

VOC compounds are defined as:

All organic compounds with a vapour pressure above 0.1 mm Hg at 20°C or, if the vapour pressure is not known, all organic compounds with 12 or less C-atoms.

Exceptions: e. g. CO<sub>2</sub> and CH<sub>2</sub>Cl<sub>2</sub> and a number of halogenated hydrocarbons such as CFC-11, CFC-12, HCFC-22, HFC-23, HFC-134 a or HFC-152 a.

This definition of VOCs therefore includes such common solvents as ethanol and isopropanol and the widely used propellants propane/butane and dimethyl ether (DME).

Thus the non-VOC components in a hair spray are therefore the polymer itself and water.

If ethanol is used as the solvent and DME as the propellant, this means:

For VOC 80: polymer + water (+ nonvolatile additives, e. g. AMP)

= min. 20% (US regulation in force)

For VOC 55: polymer + water (+ nonvolatile additives, e.g. AMP)

= min. 45% (proposed regulation in California – to take effect June 1, 1999)

### Effect of water in hair sprays in general

A high proportion of water in the hair spray changes a number of its properties in comparison with a conventional hair spray:

Change	
<b>Physical properties</b>	
Viscosity of the polymer solution	Higher viscosity → inferior sprayability
Spraying behaviour	Larger droplets → inferior sprayability, foam formation at the valve
<b>Cosmetic properties</b>	
Curl retention (after complete evaporation of the water)	Unchanged
Initial curl droop (during the drying phase)	Worse
Behaviour during the drying phase	Longer drying time, possibly tackier during the drying phase
Propellant compatibility	With more than about 10% water, it is not possible to use hydrocarbons

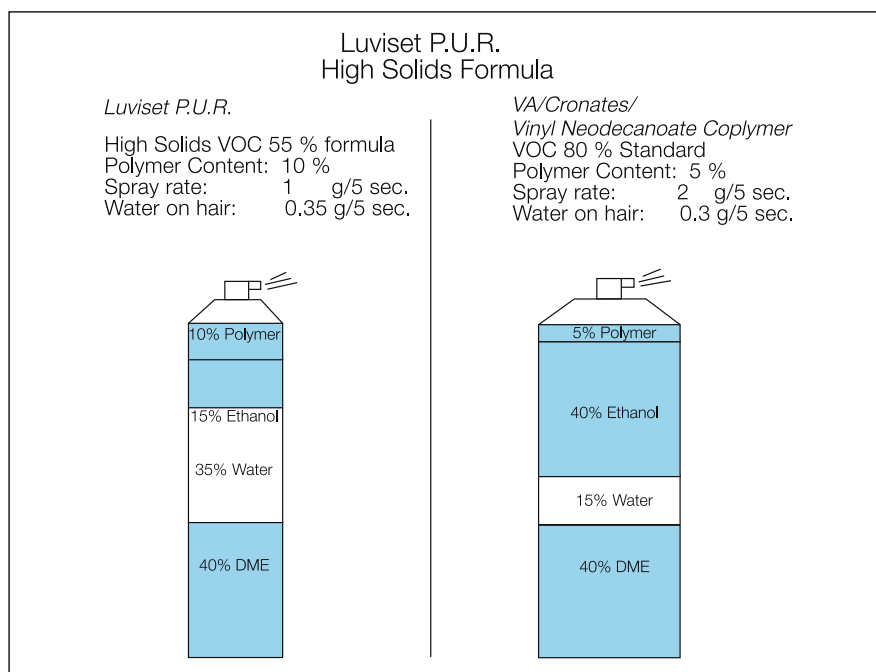
## High – solids concept

Because water has undesirable effects in hairsprays, the amount of water transferred to the hair must be reduced. This can be done by greatly increasing the polymer content in the formulation. If the spray has a high polymer content, the amount of water transferred to the hair is automatically less, for the same quantity of polymer. This, however, requires a corresponding reduction in the spray rate (cf. Columns A and B below). This is no problem with modern valves, if the viscosity of the spray solution is kept as low as possible.

<b>“High solids” principle</b>			
	A Standard VOC 55%	B “High solids” VOC 55%	C Standard VOC 80%
Ingredients (%)			
Polymer	5	10	5
Ethanol	15	15	40
DME	40	40	40
Water	40	35	15
<b>one spray application:</b>			
spray rate (g/5s)	2.0	1.0	2.0
Polymer on hair (g)	0.10	0.10	0.10
water on hair (g)	0.80	0.35	0.30

Thus, with a suitable valve it is possible to reduce the spray rate to such an extent that the quantity of water sprayed onto the hair is no more than with a VOC 80 formulation (cf. Columns B and C above). However, this is only possible if the viscosity of the spray solution is still low enough, even at the higher polymer concentration.

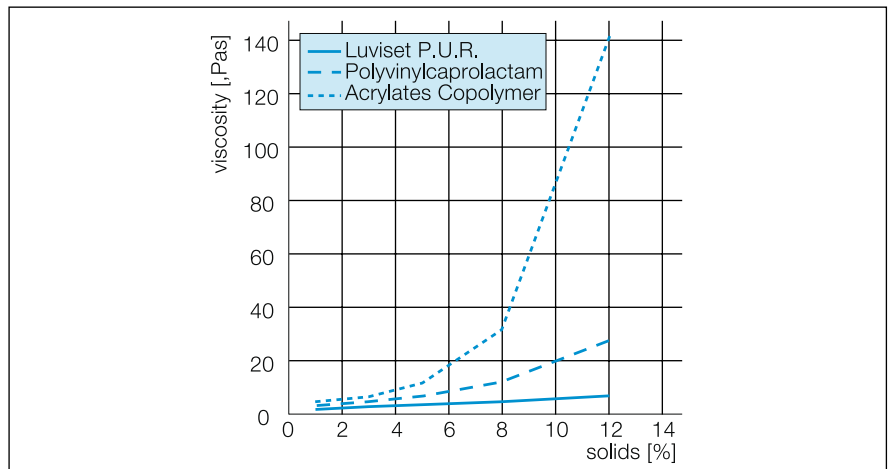
It must also be noted that a “high solids” hair spray can will be much smaller than a VOC 80 hairspray can, for the same number of applications.



## Technical properties of Luviset P.U.R.

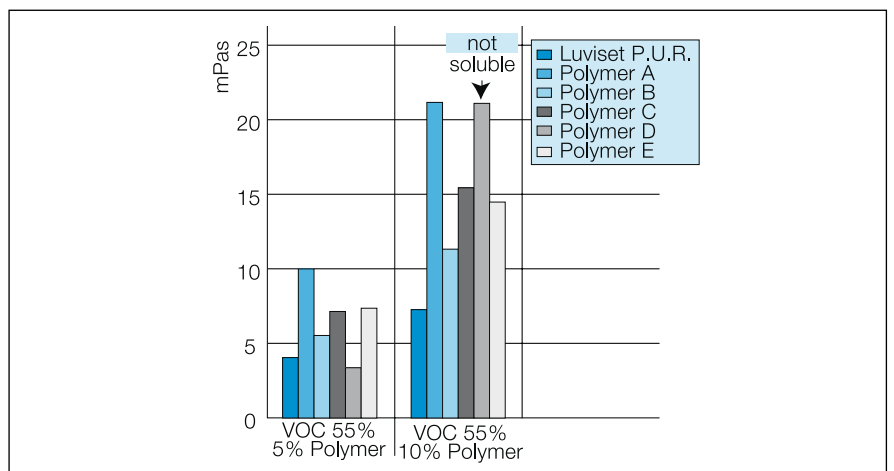
### 1 Viscosity of the polymer solution

An increase in polymer concentration usually results in an increase in viscosity, especially in the presence of water. In contrast to traditional hair spray polymers, Luviset P.U.R. shows only a very moderate increase in viscosity.



#### Viscosity of different polymers in water/ethanol 2 : 1

To assess the product in VOC 55 formulations, we compared the viscosities of VOC 55 formulations containing it and a number of other polymers recommended for these formulations at two different concentrations (5% polymer/ 40% water/ 55% ethanol; 10% polymer/ 35% water/ 55% ethanol)

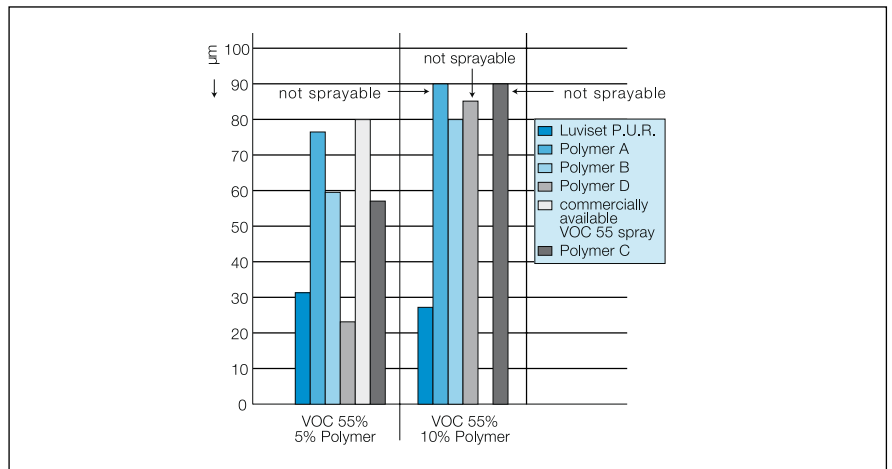


#### Solution viscosity

At both concentrations, the solutions containing Luviset P.U.R. have the lowest viscosity. The advantage of Luviset P.U.R. is particularly marked at high concentrations. It has been found that good sprayability is only provided by solutions with a viscosity of less than 10 mPa s.

## 2 Spraying behaviour

The size of the aerosol droplets in hair sprays should not exceed 40  $\mu\text{m}$  to obtain an acceptable spray pattern. Investigations of different hair sprays have shown that Luviset P.U.R., even at a concentration of 10%, can still give droplets smaller than 40  $\mu\text{m}$  in a VOC 55 formulation.



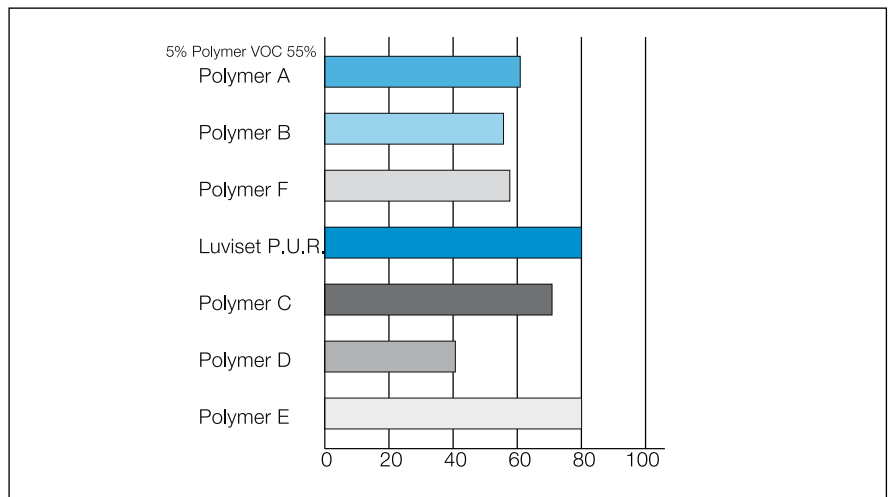
*Droplet – size – distribution*

## 3 Curl retention

The high proportion of water in VOC 55 hair sprays has no adverse effect on the curl retention properties as determined in the standard test.

This is because, in the standard method, the stretching of the curl is only measured after the polymer film has dried, so that any stretch during the drying phase is ignored.

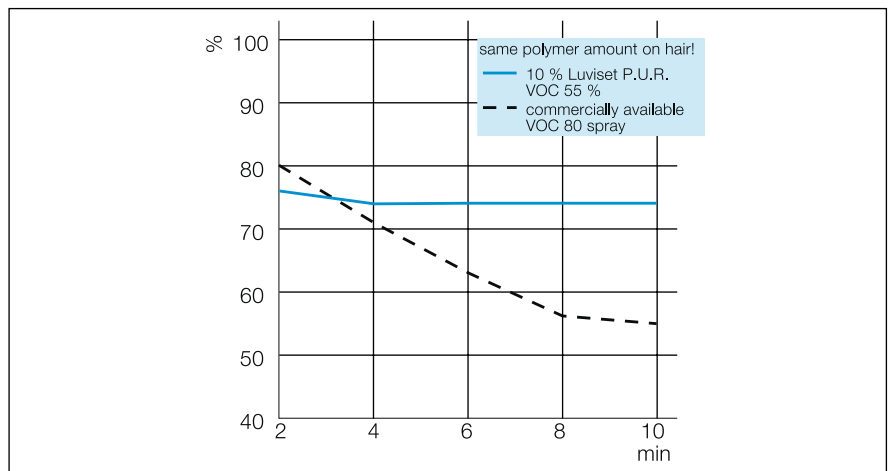
In the standard method, Luviset P.U.R. demonstrates excellent curl retention properties, even better than other commercially available polymers that are recommended for VOC 55 hair sprays



*Curl retention (%)  
(5h/25°C/90% r. h., same amount of polymer on the hair)*

#### 4 Initial curl droop

A more relevant test method for hair sprays that contain a high proportion of water is the initial curl droop method. In this test, the behaviour of the curl during the first 10 minutes after spraying, i. e. during the drying phase, is observed

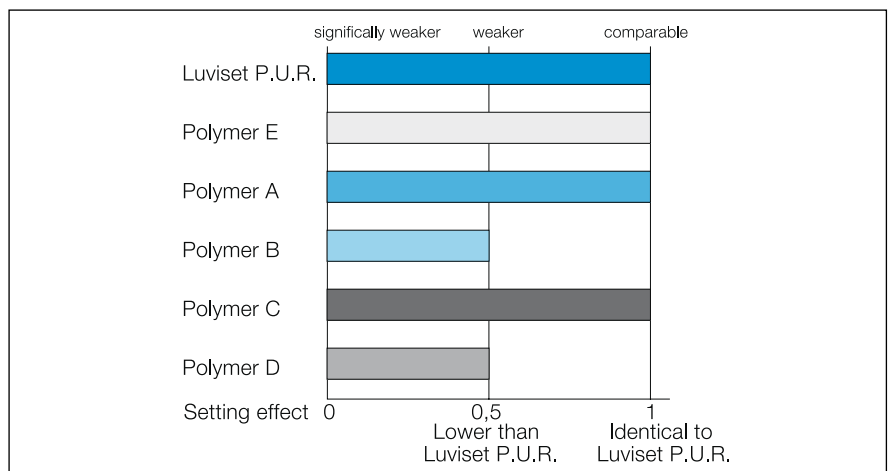


*Initial Curl Droop (%)*  
(20°C, 65% r. h., same amount of polymer on the hair)

Used according to the high solids concept, Luviset P.U.R. gives a VOC 55 hairspray that performs better than state of the art VOC 80 sprays.

#### 5 Hold

The setting effect of Luviset P.U.R. was determined in half-side tests against a series of other resins. The resins were applied in VOC 55 sprays (5% solids) and the setting effect was assessed by groups of experts. Luviset P.U.R. was applied to one side of each head and the other resin to the other side.

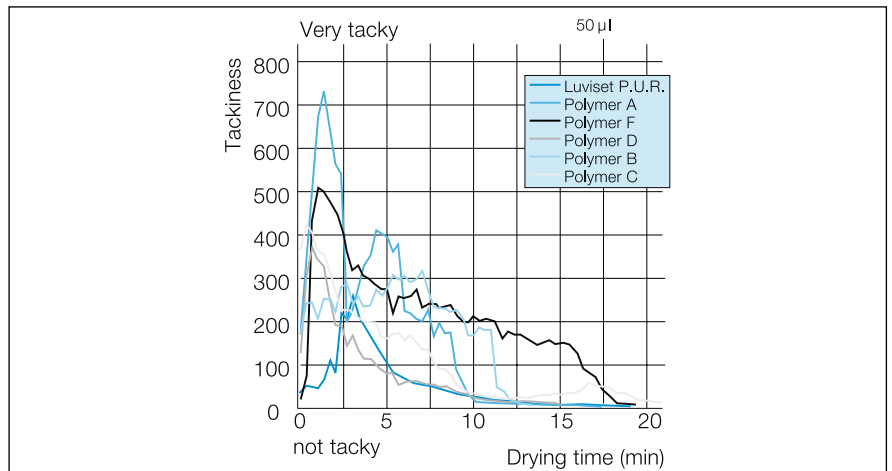


*Half-side test (Setting effect)*  
(VOC 55% formulations)

This comparative test shows that although Luviset P.U.R. has an extremely low molecular weight, none of the other resins tested has a better setting effect in a VOC 55 formulation.

## 6 Behaviour during the drying phase

The greater quantity of water in VOC 55 hair sprays not only prolongs the drying time, it also has the major disadvantage that the polymer film is frequently tacky during this time. However, hair sprays made with Luviset P.U.R. are much less tacky during the drying phase than hair sprays that contain conventional resins.



*Tackiness in the drying process  
(5% polymer VOC 55%, Diastron Tack Tester, 20°C 65% r. h.)*

## 7 Propellant compatibility

With propane/butane, a phase separation is unavoidable if the proportion of water is increased (propane/butane is then no longer miscible with water). Therefore only DME or permissible halogenated compounds such as HFC 152 a can be used as the propellant in VOC 55 sprays.

Up to 40% DME can be used in a VOC 55 formulation with a polymer content of 5–10%, while up to 30% of HFC 152 a can be used with a polymer content of 5%. Both propellants can also be used in combination.



## Examples of formulations

## Pump-Setting-Spray with Luviset® P.U.R. and Water

No. 01/01068

	%	Ingredients	Supplier	INCI name
A	30.00	Water, dem.		Aqua
	53.34	Ethanol abs.		Alcohol
	q.s.	Perfume		
B	16.66	Luviset P.U.R.	(1)	Polyurethane-1

**Production:** Weigh out the components of phase A and stir until a homogeneous solution is obtained. Add phase B to phase A and stir until a clear solution is obtained.

**Properties:** Particle size: 79 µm

## Pump-Setting-Spray with Luviset® P.U.R. and Water

No. 01/01069

	%	Ingredients	Supplier	INCI name
A	33.32	Luviset P.U.R.	(1)	Polyurethane-1
	51.67	Water, dem.		Aqua
	15.01	Ethanol abs.		Alcohol
B	q.s.	Perfume		

**Production:** Weigh out the components of phase A and stir until a homogeneous solution is obtained. Add phase B to phase A and stir until a clear solution is obtained.

**Properties:** Particle size 79 µm

Hairspray VOC 55 with Luviset® P.U.R.,  
high solid formulation; strong hold

No. 01/01054

	%	Ingredients	Supplier	INCI name
A	15.00	Water dem.		Aqua
	11.67	Ethanol		Alcohol
	q.s.	Perfume		
B	33.33	Luviset P.U.R.	(1)	Polyurethane-1
C	40.00	Dimethyl Ether		Dimethyl Ether

**Production:** Weigh out the components of phase A and dissolve them clearly. Add phase B to phase A and stir until a clear solution is obtained. Fill into appropriate containers and charge with phase C.

**Properties:** Pressure: 3.8 bar (20°C)  
Density: 0.8376 g/ml  
Cloud point: -20°C clear

**Hairspray VOC 55 with Luviset® P.U.R. strong hold****No. 01/01060**

	%	Ingredients	Supplier	INCI name
A	15.00	Water dem.		Aqua
	21.67	Ethanol		Alcohol
	q.s.	Perfume		
B	33.33	Luviset P.U.R.	(1)	Polyurethane-1
C	30.00	Dimethyl Ether		Dimethyl Ether

**Production:**

Weigh out the components of phase A and dissolve them clearly.  
 Add phase B into phase A and stir until a clear solution is obtained.  
 Fill into appropriate containers and charge with phase C.

**Properties:**

Pressure: 3.2 bar (20°C)  
 Density: 0.9160 g/ml  
 Cloud point: -26°C clear

**Hairspray VOC 55 with Luviset® P.U.R., regular formulation; normal hold****No. 01/01071**

	%	Ingredients	Supplier	INCI name
A	30.84	Water dem.		Aqua
	12.50	Ethanol		Alcohol
	q.s.	Perfume		
B	16.66	Luviset P.U.R.	(1)	Polyurethane-1
C	40.00	Dimethyl Ether		Dimethyl Ether

**Production:**

Weigh out the components of phase A and dissolve them clearly. Add phase B into phase A and stir until a clear solution is obtained. Fill into appropriate containers and charge with phase C.

**Properties:**

Pressure: 3.8 bar (20°C)  
 Density: 0.8844 g/ml  
 Cloud point: -26°C clear

**Hairspray VOC 55 with Luviset® P.U.R. and Panthenol, high solid formulation; strong hold****No. 01/01096**

	%	Ingredients	Supplier	INCI name
A	14.40	Water dem.		Aqua
	11.67	Ethanol		Alcohol
	0.50	D-Panthenol USP	(1)	Panthenol
	0.10	Phytantriol		Phytantriol
	q.s.	Perfume		
B	33.33	Luviset P.U.R.	(1)	Polyurethane-1
C	40.00	Dimethyl Ether		Dimethyl Ether

**Production:**

Weigh out the components of phase A and dissolve them clearly. Add phase B into phase A and stir until a clear solution is obtained. Fill into appropriate containers and charge with phase C.

**Properties:**

Pressure: 5.0 bar (20°C)  
 Density: 0.9215 g/ml  
 Cloud point: -20°C clear

**Hairspray VOC 80 with Luviset® P.U.R.,  
high solid formulation with Silicone****No. 01/01105**

	%	Ingredients	Supplier	INCI name
A	26.37	Ethanol		Alcohol
	0.10	Dow Corning 344 Fluid	(16)	Cyclomethicone
	0.20	Dow Corning 190 Surfactant	(16)	PEG/PPG-18/18 Dimethicone
	q.s.	Perfume		
B	33.33	Luviset P.U.R.	(1)	Polyurethane-1
C	40.00	Dimethyl Ether		Dimethyl Ether

**Production:**

Weigh out the components of phase A and dissolve them clearly. Add phase B to phase A and stir until a clear solution is obtained.  
Fill into appropriate containers and charge with phase C.

**Properties:**

Pressure: 4.4 bar (20°C)  
Density: 0.8080 g/ml  
Cloud point: -20°C clear

**Hairspray VOC 80 with Luviset® P.U.R. and Silicon oil  
„Flexible hold and pleasant feel“****No. 01/01107**

	%	Ingredients	Supplier	INCI name
A	4.90	Water dem.		Aqua
	38.34	Ethanol		Alcohol
	0.10	Wacker Belsil DMC 6031	(156)	PEG/PPG-18/18 Dimethicone
	q.s.	Perfume		
B	16.66	Luviset P.U.R.	(1)	Polyurethane-1
C	40.00	Dimethyl Ether		Dimethyl Ether

**Production:**

Add the components of phase A one after another and dissolve them clearly. Add phase B into phase A and stir until a clear solution is obtained.  
Fill into appropriate containers and charge with phase C.

**Hairspray VOC 55 with Luviset® P.U.R.,  
HFC 152 A and DME; strong hold****No. 01/01108**

	%	Ingredients	Supplier	INCI name
A	26.47	Ethanol		Alcohol
	0.10	Dow Corning 190 Surfactant	(16)	PEG/PPG-18/18 Dimethicone
	0.10	Uvinul® M 40	(1)	Benzophenone-3
	q.s.	Perfume		
B	33.33	Luviset P.U.R.	(1)	Polyurethane-1
C	10.00	HFC 152 A		Hydrofluorocarbon 152 a
D	30.00	Dimethyl Ether		Dimethyl Ether

**Production:** Weigh out the components of phase A and dissolve them clearly. Add phase B into phase A and stir until a clear solution is obtained. Fill into appropriate containers and charge with phases C and D, one after another.

**Properties:** Pressure: 4.6 bar (20°C)  
Density: 0.8373 g/ml  
Cloud point: -20°C clear

**Hairspray with Luviset® P.U.R.****No. 01/01109**

	%	Ingredients	Supplier	INCI name
A	63.24	Ethanol		Alcohol
	0.10	Uvinul® M 40	(1)	Benzophenone-3
	q.s.	Perfume		
B	16.66	Luviset P.U.R.	(1)	Polyurethane-I
C	20.00	Propane/Butane 3.5 bar (20°C)		Propane/Butane

**Production:** Weigh out the components of phase A and dissolve them clearly. Add phase B and stir until a homogeneous solution is obtained. Fill into appropriate containers and charge with phase C.

**Properties:** Pressure: 4.9 bar (20°C)  
Density: 0.7638 g/ml  
Cloud point: -6°C clear

**Hairspray with Luviset® P.U.R.****No. 01/01110**

	%	Ingredients	Supplier	INCI name
A	47.34	Ethanol		Alcohol
	q.s.	Perfume		
B	16.66	Luviset P.U.R.	(1)	Polyurethane-1
C	20.00	Propane/Butane 3.5 bar (20°C)		Propane/Butane
D	16.00	Dimethyl Ether		Dimethyl Ether

**Production:** Weigh out the components of phase A and dissolve them clearly. Add phase B into phase A and stir until a clear solution is obtained. Fill into appropriate containers and charge with phases C and D, one after another.

**Properties:** Pressure: 5.2 bar (20°C)  
Density: 0.7307 g/ml  
Cloud point: -20°C clear

**Pump setting spray with Luviset® P.U.R. VOC 80****No. 01/01104**

	%	Ingredients	Supplier	INCI name
A	66.57	Ethanol		Alcohol
	q.s.	Perfume		
	0.10	Uvinul® M 40	(1)	Benzophenone-3
B	33.33	Luviset P.U.R.	(1)	Polyurethane-1

**Production:**

Weigh out the components of phase A and stir until a homogeneous solution is obtained.  
Add phase B and stir until a homogeneous solution is obtained.

**Pump setting spray with Luviset® P.U.R. VOC 55****No. 01/01102**

	%	Ingredients	Supplier	INCI name
A	15.00	Water dem.		Aqua
	51.67	Ethanol		Alcohol
	q.s.	Perfume		
B	33.33	Luviset P.U.R.	(1)	Polyurethane-1

**Production:**

Weigh out the components of phase A and dissolve them clearly. Add phase B into phase A and stir until a clear solution is obtained.

**VOC55 Curl Revitalizing pump hair spray with normal hold and Luviset® P.U.R.****No. JB 1155**

	%	Ingredients	Supplier	INCI name
A	54.90	Ethanol		Alcohol
	0.10	Dow Corning 190	(16)	PEG/PPG-18/18-Dimethicone
	0.23	AMP	(56)	Aminomethyl Propanol
	2.75	Luvimer®Pro55	(1)	Acrylates Copolymer
	3.33	Luviset P.U.R.	(1)	Polyurethane -1
	38.49	Water dem.		Aqua

**Production:**

Add ingredients in order listed with adequate agitation, making sure all component are completely dissolved before adding the next.  
Fill into appropriate containers.

**Properties:**

Appearance: crystal clear fluid  
pH: 8.0  
Density: 0.89 g/cm<sup>3</sup>  
Valve/Pump used: Seaquist Euromist Classic 190 mcl output  
Actuator: 012x020

**"VOC 100" hair spray with Luvimer® Pro55,  
strong hold, pleasant feel and UV protection****No. 01/01271**

	%	Ingredients	Supplier	INCI name
A	13.40	Luvimer Pro55	(1)	Acrylates Copolymer
	1.14	AMP	(56)	Aminomethyl Propanol
	0.10	Dow Corning 344 fluid	(16)	Cyclomethicone
	0.10	Dow Corning 556 fluid	(16)	Phenyl Trimethicone
	0.10	Uvinul® MS 40	(1)	Benzophenone-4
	0.05	Perfume		Fragrance (Perfume)
	45.11	Ethanol		Alcohol
B	10.00	n-Butane		n-Butane
	30.00	Dimethyl ether		Dimethyl ether

**Production:**

Weigh out the components of phase A and dissolve them clearly. Fill into appropriate containers and charge with phase B.

**Properties:**

Cloud point: -35°C, clear  
 Pressure: 3.1 bar  
 Density: 0.77 g/cm<sup>3</sup>  
 Valve: Precision (Nr. M-99-008770)  
 1x.013 Nylon  
 body: 0.80 NYL KRA KAO  
 Actuator: Kosmos + Wirbel-Soft 018 MINIB  
 Diptube: STD-PE INN.3.15 205 mm

**Summary**

The tests performed demonstrate the superior performance of Luviset P.U.R. in water-containing hairsprays.

While certain other hair setting polymers may be comparable in some cosmetic properties, none matches the outstanding overall performance of Luviset P.U.R.. As an additional benefit, Luviset P.U.R. demonstrates excellent flexibility, due to its unique chemical structure.

Luviset P.U.R., therefore, is especially suitable for low VOC hairsprays, but it can also be used in VOC 80 formulations or water-free systems, whenever flexibility of hold and excellent curl retention are required.

**Suppliers**

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Telex: 46499-0 bas d  
Telefax: +49-6 21-60-4 25 25
- 16 **DOW Corning Corporation**  
P. O. Box 17 67, Dept. 2291 Midland, Michigan 48686-0994, USA  
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Fax: +1-517-496-5324
- 56 **Angus Chemical Company**  
1500 E. Lake Cook Road, Buffalo Grove, Illinois 60089, USA  
Tel.: +1-847-215-8600  
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Telefax: +1-847-215-8626
- 156 **Wacker Chemie GmbH**  
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Telefax: +49-8677-83-4735

**Stability/Storage**

The product can be stored for one year in the sealed original drums at 25°C.  
Freezing point: – 5°C

Luviset P.U.R. has been subjected to the DAB/Ph. Eur. bacterial challenge test. It was found to be adequately preserved.

**Toxicology**

An investigation of the raw material gave no indication of harmful effects to health if the substance is used for the stated applications and concentrations. Due to the large variety of applications and possible combinations with other products, users are responsible for their own safety assessment of their products.

**Safety Data Sheet**

A Safety Data Sheet is available for Luviset P.U.R.

**Note**

„While the descriptions, designs, data and information contained herein are presented in good faith and believed to be accurate, it is provided for your guidance only. Because many factors may affect processing or application/use, we recommend that you make tests to determine the suitability of a product for your particular purpose prior to use.  
NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE MADE REGARDING PRODUCTS DESCRIBED OR DESIGNS, OR THAT DATA OR INFORMATION MAY BE USED WITHOUT INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE.  
Further, you expressly understand and agree that the descriptions, design, data and information furnished by BASF hereunder are given gratis and BASF assumes no obligation or liability for the description, designs, data and information given or results obtained, all such being given and accepted at your risk.“

July 2005

