LEVOTAN® HPP

A new era of leather softening chemistry

›› Automotive softening polymer addressing the highest standards

TFL – Great chemicals. Excellent advice.

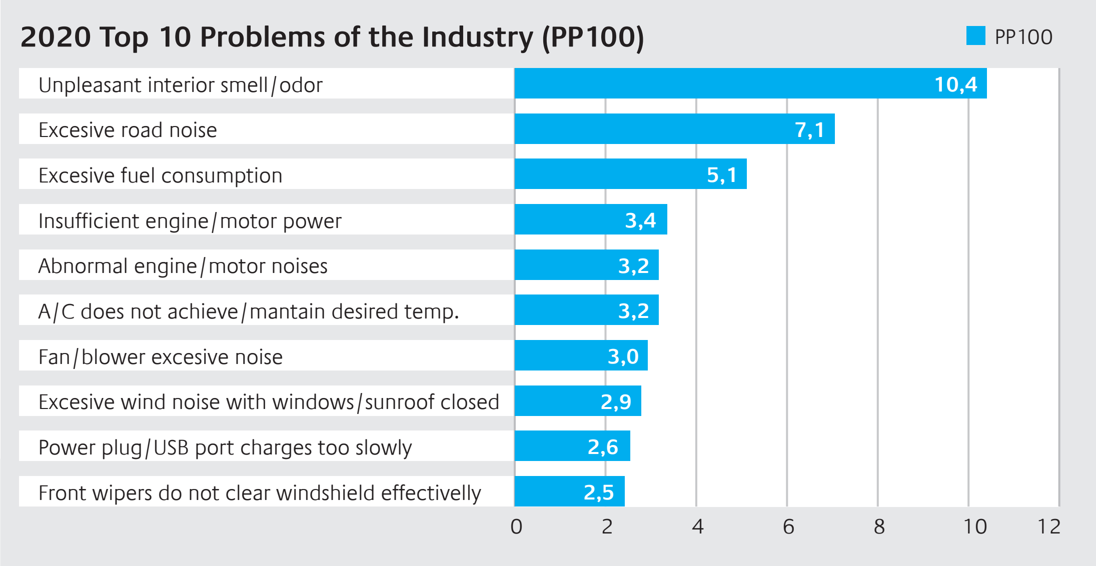
LEVOTAN® HPP

A new generation high-performance automotive softening polymer

1. Introduction

Over the last two decades, the Chinese automotive market has undergone exponential growth. The perception of smell differs in this market from others and customer complaints about unpleasant interior odors have also grown to such an extent that it is still considered the OEM´s number one challenge in this respect.

Car interior odor issues have consistently been the most complaint in the Chinese automotive market



Source: J.D. Power 2020

There are many explanations for this phenomenon apart from the perceptual differences related to culture. Due to increasing environmental pressures to reduce water and energy consumption this has led to less washing and lower drying temperatures leading to higher "residuals" in the leather. Furthermore, the increasingly demanding automotive requirements, especially regarding high heat fastness, has led the move away from certain natural products towards synthetic alternatives and, therefore, the typical leather smell has consequently changed.

Perceptual influences based on culture simply cannot be changed. We also cannot reliably measure smell by objective test machinery. Collectively this means that this odor issue presents an exceptionally difficult challenge to tackle in advance of the complaint. In other words, it is likely that this will remain an ongoing challenge.

2. Smell issues

From where does the sources of "bad" leather smell come from? There are many sources, but mainly they originate from four main ones:

- → Wet-blue or Wet-white: auto oxidation of natural fats, or certain additives like biocides or sulfur compounds
- → Fatliquors, aldehydes generated by secondary oxidation of natural fats
- → Tanning agents
- → Finishing

The Chinese automotive market is very critical about smell emanating from fatliquors, commonly associated to an "animalic" odor. No matter which type of natural raw material is used, over time it starts oxidizing and, therefore, releases a distinctive smell.

LEVOTAN® HPP is an odorless softening polymer designed to replace fatliquors and completely avoids the typical "animalic" smell source. **LEVOTAN® HPP** does not contain these problematic materials and due to its chemistry possesses extremely high heat fastness performance (no oxidation) and thus zero impact on smell.

Test results

Test Report: TA 220204, Date: 20.06.2022 I Customer: TFL – Huningue I Title: Screening – Smell

Determination of the odor characteristics of trim materials in motor vehicles according to VDA 270

→ Test method: C3 / 80°C / 2 h / 200 cm²

Sample	rating ø of 4 persons	
WB	3–4	clear perceptible, not disturbing / disturbing
Crust without product	3	clear perceptible, not disturbing
LEVOTAN® HPP	2–3	perceptible / clear perceptible, not disturbing
Polymer #1 (Oil modified acrylic polymer):	4	disturbing
Polymer #2 (Alkyl methacrylate acrylic acid):	3–4	clear perceptible, not disturbing / disturbing
Fatliquor #1 (lecithin based):	4	disturbing
Fatliquor #2 (rape seed based):	3–4	clear perceptible, not disturbing / disturbing
Fatliquor #3 (fish oil based)	4	disturbing

TFL France, S.A.S, Testing Lab, Sabine Dickhaut-Guedemann. The results are only valid for the samples tested in TFL.

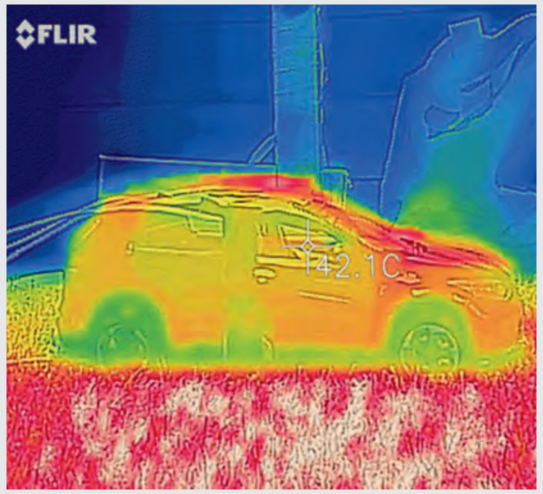
3. High heat fastness requirements (Toyota test)

Over the last two decades automotive heat yellowing requirements have steadily increased. Why? This is mainly due to two key reasons:

- Cars have been designed to become more aerodynamic with the front windscreen and rear window angled in such a way that it allows UV light pass through them at a ca. 90° angle, thus boosting the speed of heating up in car interior. In the past, UV light went through at a ca. 70° angle.
- Car interior designers started the trend to use lighter colors instead of the more traditional black or dark brown.

The speed of internal car temperatures increases is given in the below chart. For example: If the outside air temperature is 35°C, in just one hour the car interior can reach 59°C but after two hours, it could reach up to 120°C depending upon the prevailing ambient conditions.

How quickly a car heats up



					Outside air temperature	35°C
Minutes passed	70°F	75°F	80°F	85°F	90°F	95°F
10 min.	89°F	94°F	99°F	104°F	109°F	114°F
20 min.	99°F	104°F	109°F	114°F	119°F	124°F
30 min.	104°F	109°F	114°F	119°F	124°F	129°F
40 min.	108°F	113°F	118°F	123°F	128°F	133°F
50 min.	111°F	116°F	121°F	126°F	131°F	136°F
60 min.	113°F	118°F	123°F	128°F	133°F	138°F
					Internal air temperature	59°C
120 min.					→	120°C

Source: Jan Null, CCM (Certified Consulting Meteorologist); Department od Geosiences; San Francisco State University

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Therefore, the standard natural chemicals used in traditional processes such as vegetable tanning agents or animal oil based fatliquors were replaced by synthetic ones, in order to reach the demanding heat resistance requirements. However, due to this shift, the well-known "natural leather smell" has, as a consequence, disappeared.

Japanese automotive manufacturer TOYOTA started to request high heat yellowing performing articles measured by their test method TSL5101G 3.23 using the conditions of 110°C for 400hrs. The specifications for finished leather use the GS (Grey Scale) and a Grade >4 and Delta E must be <3.8 with no extraordinary change.

HONDA, on the other hand, use heat resistance test method JIS L 0804 / 8102 that is performed in a bottle (250 cm3) with the test conditions of 110°C for 200hrs and 120°C for 120hrs. Specifications for finished leather use the GS and a Grade >4 with slight change but not evident and Delta E specification of <2.0.

How to achieve high heat fastness requirements?

From the formulation point of view, it is very important to select a suitable wet-blue or wet-white from the outset, especially with an acceptably low content of residual natural fat content. However, from the chemical point of view, the major source of poor heat yellowing values are the natural based fatliquors and certain synthetic tanning agents that, although may have a very good whitening effect, may be susceptible to yellowing on exposure to heat (see pictures on the following page).

Why LEVOTAN® HPP?

The chemistry of **LEVOTAN® HPP** achieves the highest heat yellowing requirements giving the possibility to combine or to replace 100% of the standard automotive fatliquors depending on the article required, chrome or chrome-free.

The partial replacement of synthetic tanning agents is also possible by using the right balance between acrylic polymers (e.g., **MAGNOPAL®** and/or **LEUKOTAN®** range) combined with protein fillers such as **SELLASOL® FSU**.

The application of **LEVOTAN® WS** in combination with, for example, **LUBRITAN® GXL** can impart to the leather excellent softness and tightness after the milling process, especially with chrome-free material.

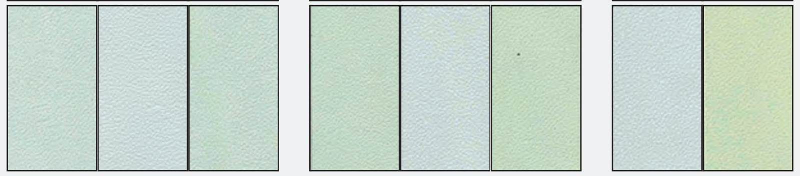
LEVOTAN® HPP is a biodegradable, compostable and yet oxidation resistant (fatty acid-free), the odorless polymer. It also possesses extreme fastness under heat and light exposure without the risk of Chrome VI formation.

As fatliquoring has a strong impact on these requirements, **LEVOTAN® HPP** was specially designed to replace up to the complete offer of natural based fatliquors and confer excellent performance on automotive articles such as fogging gravimetric, reflectometric and haze, as well as extremely low emissions and COD values.

Heat fastness comparison natural fatliquors vs LEVOTAN® HPP

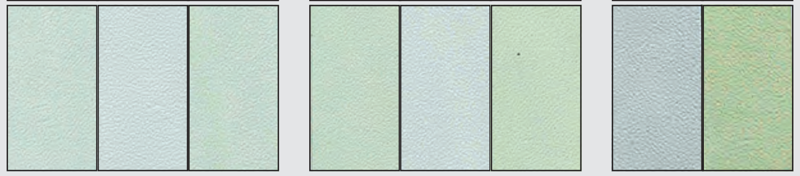
Reference – Crust w/o FL or HPP

3 days 100°C	Tq	6 days 100°C	3 days 120°C	Tq	6 days 120°C	Tq	17 days 110°C



LEVOTAN® HPP

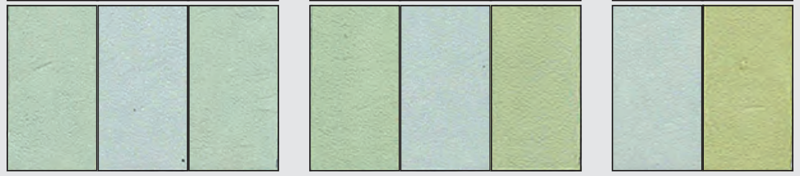
3 days 100°C	Tq	6 days 100°C	3 days 120°C	Tq	6 days 120°C	Tq	17 days 110°C



1,20 4,30	*ΔE *GS	0,37 4,79	0,34 4,77	*ΔE *GS	0,92 4,46	*ΔE *GS	1,05 4,39

Animal Source

3 days 100°C	Tq	6 days 100°C	3 days 120°C	Tq	6 days 120°C	Tq	17 days 110°C



3,04 3,23	*ΔE *GS	1,97 3,85	3,56 2,96	*ΔE *GS	5,14 2,44	*ΔE *GS	6,59 2,13

Vegetable Source

3 days 100°C	Tq	6 days 100°C	3 days 120°C	Tq	6 days 120°C	Tq	17 days 110°C

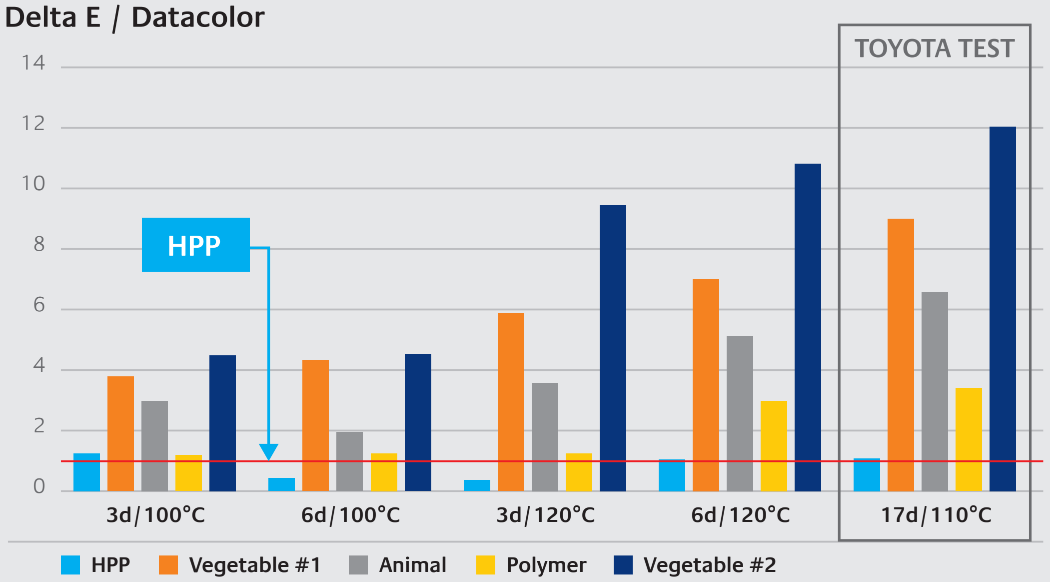
3,83 2,84	*ΔE *GS	4,43 2,63	5,89 2,24	*ΔE *GS	6,98 2,01	*ΔE *GS	9,06 1,68

*ΔE & *GS = ISO 105-A05 MEASURED WITH DATACOLOR

Heat yellowing (Delta E / Datacolor)

Material	3d/100°C	6d/100°C	3d/120°C	6d/120°C	17d/110°C
HPP	1,2	0,37	0,34	0,92	1,05
Vegetable #1	3,83	4,43	5,89	6,98	9,06
Animal	3,04	1,97	3,56	5,14	6,59
Polymer	1,12	1,14	1,10	2,90	3,54
Vegetable #2	4,54	4,52	9,43	10,73	12,07

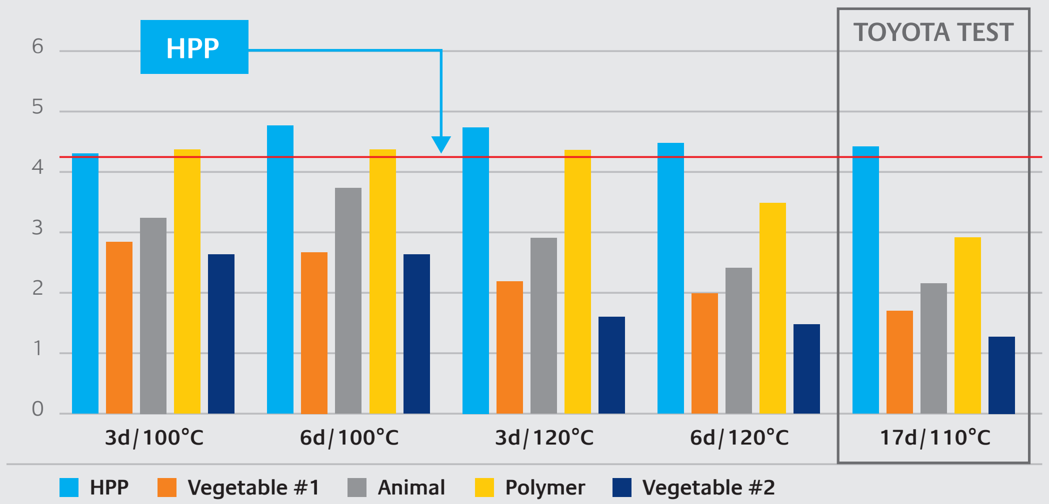
Delta E / Datacolor



Heat yellowing (grey scale / Datacolor)

Material	3d/100°C	6d/100°C	3d/120°C	6d/120°C	17d/110°C
HPP	4,30	4,79	4,77	4,46	4,39
Vegetable #1	2,84	2,63	2,24	2,01	1,68
Animal	3,23	3,85	2,96	2,44	2,13
Polymer	4,34	4,33	4,35	3,32	2,98
Vegetable #2	2,60	2,61	1,58	1,42	1,28

GS / Datacolor



Fastness comparison sulphone syntan (WB)

4. Compostability (biodegradability)

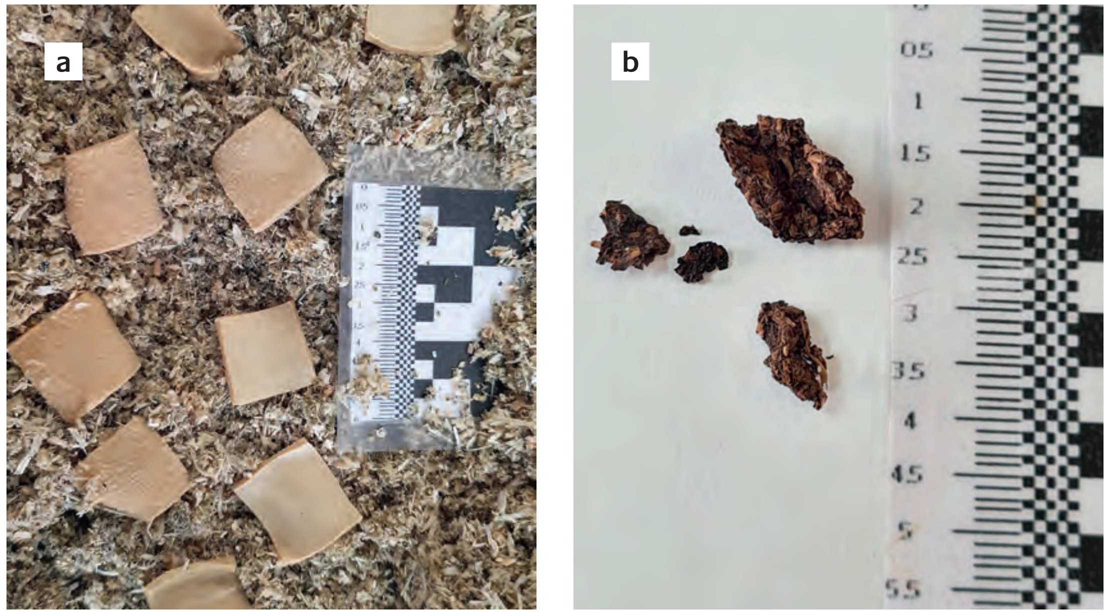
Leather treated with **LEVOTAN® HPP** is compostable.
"Compostable materials are those that degrade by biological processes to yield CO2, water, inorganic compounds and biomass at a rate consistent with biodegradation of natural waste while leaving no visually distinguishable remnants or unacceptable levels of toxic residues." (ASTM International 2012).

4.1. Compostability of chrome-free leather with LEVOTAN® HPP

Table 1: Wet White Leather degradation residues after 90 days completion of the thermophilic part immediately followed by 90 days of mesophilic part of compostability test according to ISO 20200.

	ISO 20200 disintegration after composting		
Stage	**Thermophilic 90 days**	**plus**	**Mesophilic 90 days**
Leather sample with LEVOTAN® HPP	**82.95 ± 1.78 %**		**97.42 ± 1.17 %**
Reference sample FOC leather alone	**76.76 ± 5.62 %**		**89.69 ± 8.21 %**

Fig.1. FOC Leather with **LEVOTAN® HPP** (a) at the beginning of the test, (b) degradation residues after 180 days completion of the ISO 20200 compostability test (values are given in cm).



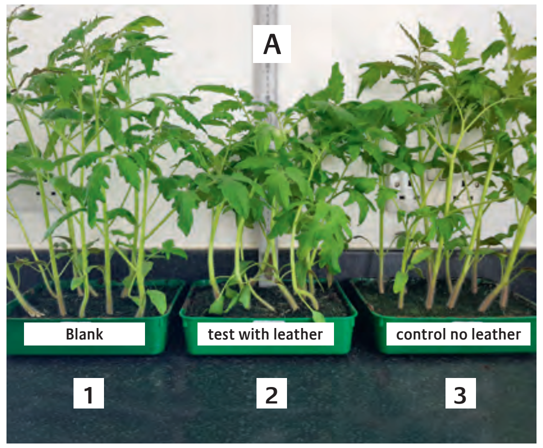
Test done by Authenticae Ltd.

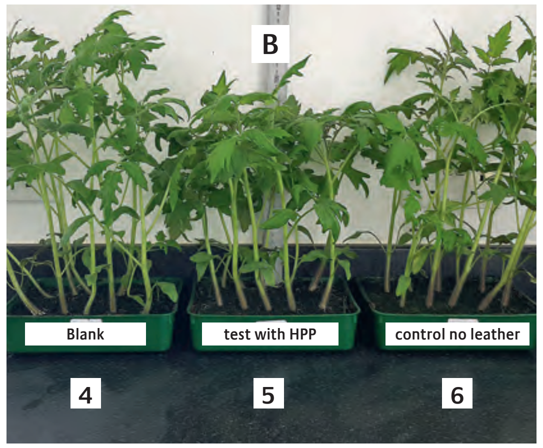
4.2. Ecotox after disintegration of FOC leather with LEVOTAN® HPP

Levels of toxic chemicals after thermophilic part (90 days) show very little concern for leather sample.

4.3. Plant response test according OECD208 and REAL CCS 3.1 (WRAP 3.1)

Fig.2. Plant growth after 28 days in compost containing (A) FOC leather without **LEVOTAN® HPP**; (B) FOC leather with **LEVOTAN® HPP**. Comparison with blank and control without leather.





Test done by Authenticae Ltd.

Table 2:	OECD 208 and REAL CCS 3.1 (WRAP 3.1) plant response tests			
	TgFM [(1)] (g)	TgFM/plant [(2)] (g)	Plant Height (mm)	Observations
Leather sample with LEVOTAN® HPP (5)	62,4	6,68	300	some stem twisting, surface rooting & chlorosis
Control no leather (6)	72,8	7,53	400	No
Reference sample FOC alone (2)	60,4	6,47	300	some stem twisting surface rooting & chlorosis

(1) TgFM is the total top growth fresh mass of plant at 28 days.
(2) is the mean top growth fresh mass per plant at 28 days.

The two test samples (FOC leather with and without **LEVOTAN® HPP**) grew less than the Blank and control samples in top growth, and in plant height indicating that **LEVOTAN® HPP** do not significantly impact plant growth behavior.

5. Summary

LEVOTAN® HPP is a new generation of softening polymers, taking care of the latest environmental standards and specifically designed to meet the highest automotive requirements.

Smell
- VDA270 (C3/D4/D5)
- FLTM BO 131-03
- TSM0508G-2009

Emissions
- VDA278
- VDA277
- GMW 15635
- FTLM BZ108-01 (10L Bag Test)

Fogging
- ISO 17071
- TSM0503G
- HES D6508-A
- NES M0602

Physicals
- TSL 5101G 3.5.2 & 3.4.2
- ISO 3376
- ISO 3377-1
- ISO 2420 (Specific weight)

COD
- ASTM D1252-06-2020

Heat and light fastness
- ISO 17228
- TSL 5101G 3.23
- ISO 105-B02 (Xenon Test)
- ISO 17228 (Climate ageing)

Biodegradability
- ISO 20200 (Compostability)
- OECD208 (Ecotox)
- BOD 28 (Zahn-Wellens)

Thermal stability
- FMVSS 302 (Flammability)
- TL 52064 17.2 & 17.4 (Chamber test VW Audi)
- BMW AA 0420 (Hydrolysis)
- ISO 3380 (Shrinkage temperature)

Acetaldehyde
- DIN 17226-1
- VDA 275
- TSM0508G-2009

08-2022

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