Improving the odour of automotive leather

Lukas Wohlmuth, Leather Technician; Andy Schweizer, R&D Chemist and Siegfried Nagel, Director Business Unit Leather at German chemical specialist Schill & Seilacher, examine how vehicle interior air quality (VIAQ) can be refined by balancing leather odour intensity through innovative absorber technology.

In the leather industry, we have to deal with a globalised world with complex, interwoven supply chains and varying consumer demands, as well as a host of different aspects such as brand perception and loyalty, varying customer preferences in different global automotive markets, strict legislations like GB/T 27630 in China, non-uniform OEM specifications, subjective association of bad smell and health influence, cultural influence on olfactoric preferences, balancing luxury and technological demands, driving pleasure and shared mobility and so on.

The reasons why tanners are facing the need to improve, reduce or adjust the odour of automotive leather are as numerous as the options within the entire leather making process to do so. From beamhouse to finishing, those options are of direct or indirect influence on the leather, and due to their extent should be discussed separately in depth. Broadly speaking, it is all about avoidance and reduction.

The recommendation to avoid the use of recycled water in beamhouse, for instance, is a reasonable yet unfeasible one. It would counteract the tanner's ambition to work sustainably by saving fresh water, and furthermore, would require severe technical changes of the production facility and processing streams.

It is known that breakdown products of liming, such as the amines skatole and indole, are main malodour compounds and consequently responsible for bad smell, but room for manoeuvre seems rather limited. Also, with regards to production consistency, the beamhouse operation ought not to change too much. Only a few recommendations to cope with malodorous compounds generated in beamhouse seem rational, such as thorough washing after the liming operation – unfortunately, very often, again by using recycled water carrying malodorous compounds back into the system.

A further example is the recommendation to reduce the input of chemicals known for strong inherent smells. Aldehyde-based tanning and retanning agents, with their pungent smell, are a good example. Some natural-oil-based fatliquors tend to drift to a rancid smell (especially when not protected against oxidation), vegetable tannins and syntans to roasty or rubbery smells and finishing coats can emit sweet odour notes.

The input of these chemicals, along with the decomposition products from beamhouse, are accountable for the overall odour intensity of the leather (Figure 1).

Following that, which options does the tanner have to balance out the overall odour spectrum?

Screening every leather auxiliary for intense odour and replacing it with the best available alternative would be a mammoth task for a tannery, considering the time and amount of work this evaluation would require. Again, this would result in too many adjustments of the whole process. The leather character could drift towards a direction that is neither desired by the customers (the OEMs), nor meets their specifications.

To overcome the dilemma of not compromising pleasant odour at the expense of process consistency and leather quality, odour absorbing technology has been made accessible to the tanner.

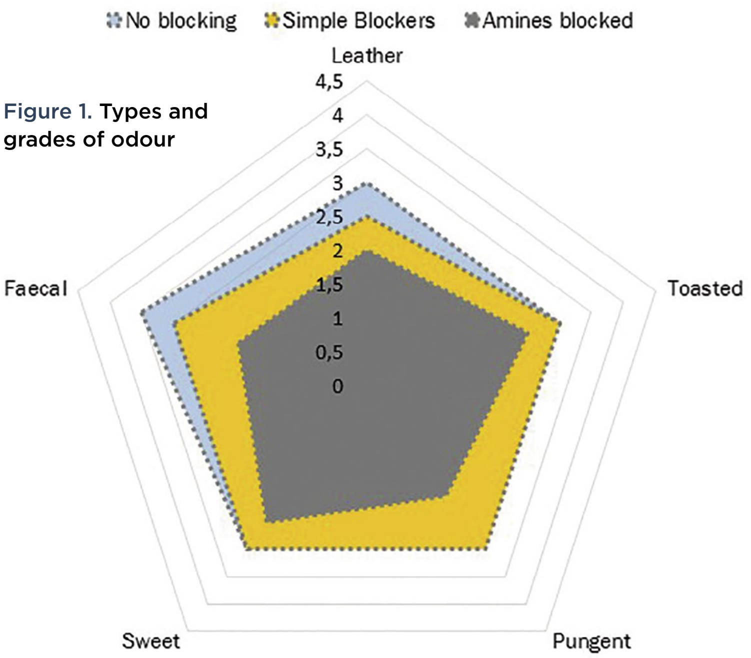
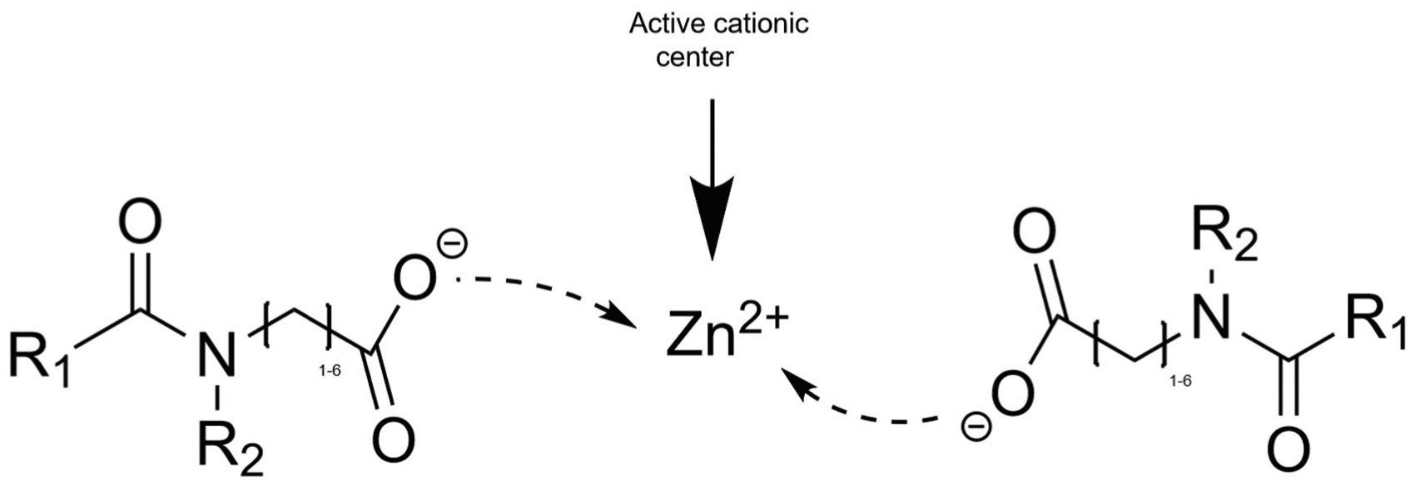


Figure 1. Types and grades of odour



R_1= Saturated or unsaturated branched or linear carbon chain from the fatty acid

R_2= Short carbon chain from the amino acid or H

Figure 2. Structure of Zn-acylaminoacid

The status quo of odour absorbers

Zinc ricinoleate, which is widely used in personal care products such as deodorants or household applications such as detergents and textile fresheners, has been one of the first choices for odour absorbers in leather auxiliaries.

It is known that the chemical mechanism of odour absorption by zinc ricinoleate revolves around the active cationic centre of Zn^{2+}. Malodour molecules based on sulphur and nitrogen such as skatole and indole, which belong to the most common natural malodors, dock on the active centre and are held in place by the ricinoleic acid side chains. However, this process only takes place if the active centre is accessible to these malodorous compounds. In order to perform, the zinc ricinoleate needs to be 'activated' using chelating agents. Due to these additional chelating agents, the application of zinc ricinoleate as odour absorbent in the leather making process is rather limited. Its narrow solubility range makes zinc ricinoleate applicable only in fatliquors of non-polymer origin. In contrast, the latest developments of odour absorbers make use of the same mechanism described above, but can cover a much wider range of application.

Tailoring odour absorber technology

An innovative chemical approach uses the self-emulsifying qualities of the new zinc-acylaminoacid based odour absorber (Figure 2) and its subcategory zinc salt of oleoylsarcosinate. By avoiding the use of additional chelating agents, the absorber's solubility characteristics are less limited, which provides it with compatibility to a much wider range of leather auxiliaries, such as aqueous and organic solvent based polymer dispersions, degreasing agents and surfactants, as well as finishing coats. This is an entirely new field for the application of chemically active odour absorbers.

The self-emulsifying properties of the molecule help it to stay open to any complex nitrogen or sulphur containing organic malodour molecules and furthermore help to penetrate into the collagen structure and disperse the odour absorbers evenly in the leather.

The special side chains that surround the Zn^{2+} cationic centre contain amino acid building blocks. Those enable the absorber molecule structure to bind to a wider range of odour molecules than the aforementioned zinc ricinoleate. The nitrogen atoms within the molecule can be charged or partially charged. Hence, there are more bonding possibilities for negative charges within the odour molecules. While it is not possible for any odour absorber to neutralise highly volatile organic acids, this new molecule at least provides the possibility to capture low volatile or large complex organic acids. Therefore, dominating malodorous compounds creating a peak in the odour spectrum can be reduced (Figure 3).

How can the above mentioned odour absorber technology be made practically applicable to the tanner?

Application of odour absorbers in fatliquoring and finishing

To ensure a thorough penetration and distribution of odour absorbers in wet-end, a liquid leather auxiliary needs to act as a 'carrier'. This auxiliary furthermore should be applied in large quantities with a relatively long exposure time to the hide. Therefore, fatliquors represent suitable substrates to carry absorbers into the leather.

The general guidelines for fatliquoring odour optimised automotive leather simultaneously are of benefit for active odour absorbers. Depending on the specifications of the final article, the use of 9% to 15% of a high quality fatliquor mixture with a run time of approximately 90 to 180 minutes is recommended. In addition to thorough penetration and distribution, a more regular coating of the fibres with the absorber containing fatliquor is obtained.

Inside the hide, the capturing of malodour compounds by odour absorbers takes place at the interface of the fatliquor coated collagen fibres and the aqueous environment (similar to the mechanism illustrated in figure 4). Previous odour absorbers based on zinc ricinoleate have been limited by their solubility characteristics and could solely perform at this oil/water interface.

On the other hand, new absorbers based on zinc-acylaminoacid are not limited in their function to this interface anymore. The absorber's upgraded solubility provides access to a much higher quantity of malodorous compounds in aqueous environment. Those malodours can derive from the wet-white, wet-blue or the chemical products themselves. A further

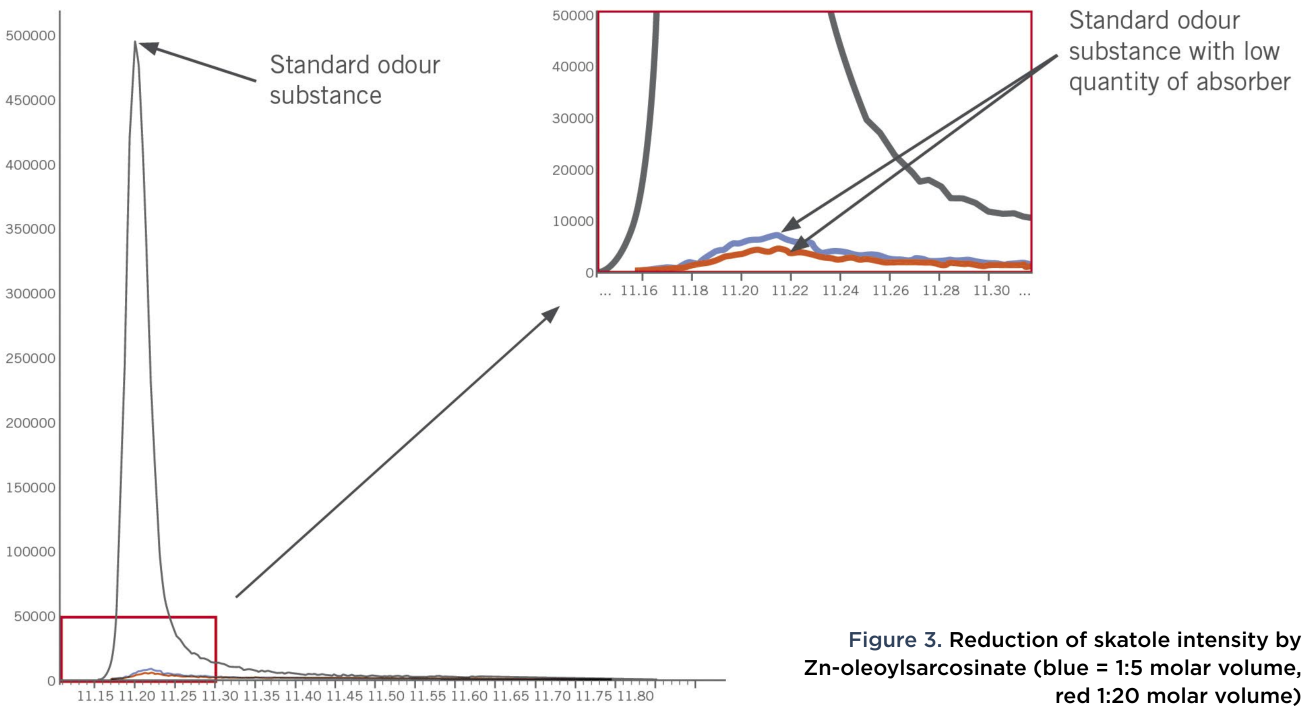


Figure 3. Reduction of skatole intensity by Zn-oleoylsarcosinate (blue = 1:5 molar volume, red 1:20 molar volume)

benefit of this upgrade is the compatibility of absorbers with state-of-the-art polymer-based fatliquors.

Thanks to low emission levels (VOC, fogging and odour), low tendency to migration, high physical performances and light weight characteristics, those kinds of fatliquors are the first choice for the production of automotive leather.

The advantage of polymer-based fatliquors to strongly fix to the collagen fibres also helps to keep the odour absorbents in place, resulting in long-term protection.

Low of inherent smell and equipped with odour absorbers, fatliquors represent one of the most effective tools to reduce and balance leather odour.

But thanks to the extended solubility characteristics, the absorbers used in those fatliquors can go past the limit of application in wet-end and also show their potential in finishing.

As these absorbers have been made soluble in aqueous polymer solutions, leather finishing represents a further application field for this technology. Most suitable as a carrier for the absorbers would be a liquid finishing product that is advantageously coated or sprayed in large quantities onto the leather surface.

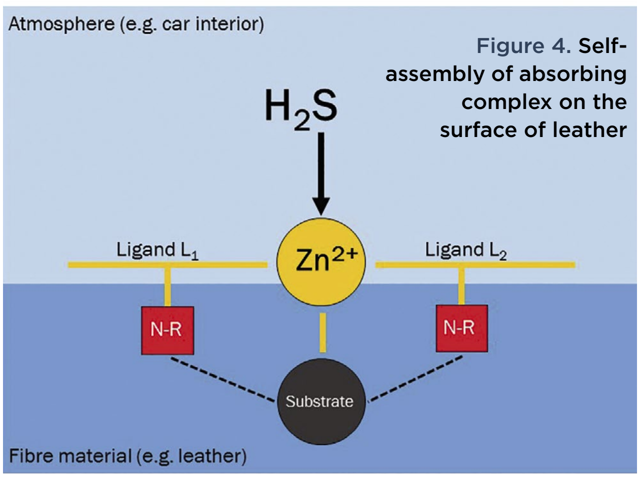


Figure 4. Self-assembly of absorbing complex on the surface of leather

Therefore, a basecoat with its high grams per square foot application (either by spraying or rollercoating) is a suitable substrate for the odour absorber. Once dried, the finishing film permanently holds the odour absorbers in place. The same applies for the use of absorbers in intermediate or top coats as well as in flesh side gluing.

Finishing coats equipped with this odour absorbent technology not only have to suppress undesired odour notes potentially emitted by the crust leather underneath, they also need to protect the leather surface from picking up malodours deriving from the atmosphere – e.g. car interior (Figure 4).

In the best case, this interface exhibits a resilience against malodour impact and only leaves behind the pleasant odour notes of leather.

Conclusion

As a result of the latest innovations, the tanner can now make use of a much broader selection of practically applicable odour absorbers and use them in numerous process steps - particularly in those where need for action is required.

But despite all efforts producers make to reduce the inherent smell of leather for automotive interiors, we should not forget that we are dealing with a material that is advertised as a natural one by tanners as well as OEMs. Thus, all its characteristics should signalise the customer's senses to detect it as leather. Apart from haptic, look and even sound, odour plays an important role to differentiate leather from other natural or synthetic materials, making it desirable and - first and foremost - sellable.

Rather than reducing the smell of leather to the utmost minimum, we should balance its odour to a level which is pleasant and acceptable for all customers and drivers of all cultural backgrounds worldwide. We should not entirely hide leather smell, but highlight the natural nuances of its fragrance, always with regards to meet VIAQ standards. This seems to be a demanding task, but by understanding the principles of avoidance, reduction – and now even absorption - the tanner can balance out and adjust this unique scent. Odour absorbing technology can contribute a significant part to this – literal - balancing act.