Sustainable tanning: chrome and FOC

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Requirements for sustainable tanning – chrome and FOC

Introduction

- Tanning: key process in leather production; tanning chemicals are the “operating system”
- Tanning (cross-linking of fibers) requires reactive chemicals
- Five specific sustainability requirements

Chrome and FOC have different performance profile: choice of tanning is depending on application

5 specific sustainability requirements

- Safe handling
- Reduction of process water & pollution
- Irreversible Tanning (fixation)
- Safe degradation product(s)
- Chemicals react to full extent / exhaustion
Chrome Tanning Salts (CTS) – LANXESS ensures “0ppm Cr(VI)”

Chrome: handling of CTS

Chrome tanning: most common tanning process globally. Only 5% of total chrome production used for tanning

Evaluation of handling CTS:

- Risk-assessment proves safe handling during tanning process
- Potential issue: CTS supplier needs to ensure product Cr(VI)-free
- LANXESS is backwards integrated with own chrome mine
- LANXESS capable and committed to completely avoid Cr(VI) in CTS
- Every batch tested and approved for “0ppm Cr(VI)”
Chrome: irreversible fixation and high exhaustion achievable

**Irreversible tanning & chemicals react to full extent**

**Evaluation of fixation**
- Chrome gives irreversible reaction with collagen
- Avoidance of Cr(VI) in leather:
  - High performance softening chemicals with low iodine number
  - Crust with reductive matrix

**Evaluation of reaction completion**
- CTS react fast with carboxylic groups of collagen
- High exhaustion of chrome achieved by temperature, pH and special chemicals/ process
- Alternative infrastructure: lower float exhaustion, precipitation of effluent and recycling of chrome
Chrome: degradation and water management

<table>
<thead>
<tr>
<th>Safe degradation product(s) &amp; reduction of water pollution</th>
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<tbody>
<tr>
<td><strong>Evaluation of degradation</strong></td>
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<tr>
<td>- Chrome itself does not degrade, waste must be competently managed and recycled</td>
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<tr>
<td>- Recycling of shavings: hydrolytic or pyrolytic recycling followed by precipitation and re-use of chrome</td>
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<td>- LANXESS Chrome Competence Center is developing processes for shavings and potentially for leather recycling</td>
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**Water consumption**

- Water consumption during chrome tannage is quite low

**Chrome most common tannage; Intelligent process control ensures highly sustainable production**
X-Tan® is an innovative wet white tanning system

**X-Tan®: handling and fixation**

- Conventional wet white system shows room for improvement from sustainability point of view
- X-Tan®: innovative tanning based on Polycarbamoylsulfonate (PCMS)

**Evaluation product handling**

- Risk assessment proves safe handling during tanning process

**Evaluation of irreversible tanning**

- Very fast and complete reaction with amino groups in collagen
- Irreversible reaction: CMS reacts with amino acid lysine of collagen under Na-bisulfite release resulting in cross linking (stable urea groups)

\[
\text{Collagen-NH}_2 + \text{Na}^+ \cdot \text{O}_3\text{S} \rightarrow \text{CMS - Group} \rightarrow -2 \text{NaHSO}_3
\]

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\]

R = Hydrocarbon residue with a divalent or a polyvalent functionality
Cross linking consists of a statistical mixture (chain lengths).

Evaluation degradation
- Degradation with water leads to aliphatic amines & urea: toxicologically uncritical.

X-Tan®: exhaustion & degradation

**Evaluation exhaustion**
- PCMS reacts to full extent
  - 1. Rxn with amine (collagen) leads to urea bonds
  - 2. Rxn with water leads to amine with release of CO₂, potential reaction with
- Reaction with amine ~1.000 times faster than with water
- Possible chain elongation when no lysine directly available
- Cross linking consists of a statistical mixture (chain lengths)

**Evaluation degradation**
- PCMS reacts to full extent
- 1. Rxn with amine (collagen) leads to urea bonds
- 2. Rxn with water leads to amine
- Reaction with amine ~1.000 times faster than with water
- Possible chain elongation when no lysine directly available
- Cross linking consists of a statistical mixture (chain lengths)
X-Tan® – improved water quality due to avoidance of pickling

**Evaluation of water**
- Major difference of processes:
  - X-Tan® process is significantly shorter
  - X-Tan® tanning process in neutral-alkaline pH
  - X-Tan® process: no pickle required
- Effluent contains significant less salt
- Energy consumption decreases by 10%

**Tanning process comparison vs. conventional wet white system**

**Comparison X-Tan® vs. standard wet white – process**
Course of pH-value / duration

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- X-Tan® - Process
- Std. WW - Process
**X-Tan® – combination of sustainability with performance advantages**

### Major product advantages of X-Tan® vs. conventional wet-white tanning

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<tr>
<th>Sustainability</th>
<th>Handling</th>
<th>Performance</th>
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<tr>
<td><strong>100 % conversion</strong></td>
<td><strong>Safe &amp; easy</strong></td>
<td><strong>White white</strong></td>
</tr>
<tr>
<td>▪ X-Tan® reacts to full extent</td>
<td>▪ X-Tan® process can be easily handled and controlled (on/off)</td>
<td>▪ Excellent whiteness vs. standard wet white</td>
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<tr>
<td>▪ Shavings / Effluent contain toxico-logically uncritical products</td>
<td>▪ Non-sensitizing tanning agents</td>
<td>▪ Brilliant colors</td>
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<tr>
<td>▪ Energy consumption decreases by 10%</td>
<td>▪ Process time decreases by 10%</td>
<td>▪ Dyeing: uniform on surface and evenly penetrated cross-section</td>
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<td><strong>Clean waste water</strong></td>
<td><strong>Robust</strong></td>
<td><strong>Strong and soft</strong></td>
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<tr>
<td>▪ AOX-free</td>
<td>▪ X-Tan® process provides excellent penetration, even in thick pelts at neutral pH</td>
<td>▪ High tear-resistance and good touch &amp; feel</td>
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<td>▪ X-Tan® process requires no pickling, resulting in substantially less salt freight, particularly chloride</td>
<td>▪ Wet whites produced with X-Tan® can be easily shaved</td>
<td>▪ Good thermo dimensional and transport stability</td>
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<td>▪ Potential yield increase</td>
<td>▪ Leather is biodegradable</td>
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| Safe & easy                                                                  | Robust                           | Strong and soft                  |
|                                                                              |                                  |                                  |
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Energizing Chemistry