
Guidance 13:
Leather coating

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1 Introduction

This guidance addresses leather coating activities and the related cleaning of equipment, presenting options to substitute or reduce the use of VOC and its resulting emissions.

Table 1: Scope definition of the VOC Solvent Emission Directive (SE Directive)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Solvent consumption threshold [tonnes/year]</th>
<th>ELVs in waste gases [mg C/Nm³]</th>
<th>Fugitive emission values [% of solvent input]</th>
<th>Total ELVs [g/m²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating of leather</td>
<td>&gt;10</td>
<td></td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>For leather coating activities in furnishing and particular leather used as small consumer goods like bags, belts, wallets, etc.</td>
<td>&gt; 10 – 25</td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Other coating of leather</td>
<td>&gt; 25</td>
<td></td>
<td></td>
<td>75</td>
</tr>
</tbody>
</table>

Special provisions: Emission limits are expressed in grams of solvent emitted per m² of product produced.

Coating of non-natural leather may be covered by other activities under the SE Directive which are addressed by other guidance documents: for coating of plastics and fabric see guidance 8 part 2.

Leather surface cleaning (e.g. sheepskin degreasing) using VOC solvents may also be covered by the SE Directive (see guidance documents 4/5). Finishing activities of footwear using VOC may be covered by the SE Directive under ‘footwear manufacture’ (see guidance document 14).

The SE Directive lays down the following activity specific emission limit values for leather coating:

Table 2: Emission limit values of the SE Directive

THE SE DIRECTIVE APPLIES TO LEATHER COATING IF A SOLVENT CONSUMPTION OF 10 TONS PER YEAR IS EXCEEDED
As the total VOC emission limit value refers to square meters of product produced, the annual leather production (in terms of surface of each of the two product groups mentioned above) has to be documented accordingly. Instead of complying with the above ELVs, operators may choose to use a reduction scheme, following the specifications of Annex II (B) of the SE Directive.

Specific requirements apply for VOCs classified as CMR substances\(^1\) as well as for halogenated VOCs which are assigned the risk phrases R40 or R68\(^2\). There is a general obligation to replace CMR substances— as far as possible – by less harmful substances or preparations within the shortest possible time. In the case of a mass flow $\geq 10 \text{ g/h}$ for VOC classified as CMR substances or $\geq 100 \text{ g/h}$ for halogenated\(^3\) VOC with R40/R68 the ELVs in waste gases are 2 and 20 mg/Nm\(^3\) respectively, and these also apply when a reduction scheme is being used.

National legislation may define lower thresholds for solvent consumption, stricter ELVs or additional requirements.

2. **Summary of VOC substitution/reduction**

The largest VOC emissions result from the application of solvent-based coatings. Less significant VOC emissions may result from water-based coatings and from cleaning of equipment.

Switching to water-based coating systems is the most effective VOC substitution measure. These can produce top quality results for a wide range of product requirements and have already replaced many solvent-based systems.

Water-based (alkaline) cleaning systems can generally clean equipment that has been used to apply water-based coatings, reducing further the emissions.

Water based systems may, nevertheless, emit VOC because they often contain some organic solvent to dissolve binders (0 - 15 % VOC, with ethyl

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\(^1\) CMR substances – carcinogenic (R45, R49), mutagenic (R46), or toxic to reproduction (R60, R61)

\(^2\) After the implementation of the SE Directive a revision of the R-phrase R40 took place. The original wording of R40 was: ‘Possible risk of irreversible effects’. The new wording is: ‘Limited evidence of a carcinogenic effect’. In the ‘old’ version mutagenity (cat 3) was included. This mutagenic effect is now covered separately under R68: ‘Possible risk of irreversible effects’. This new risk phrase does not include carcinogenicity. The ‘new’ version of R40 is obviously less restrictive than the old version. Until the SE Directive is adapted to this change, a final decision on which version applies can only be given by the European Court

\(^3\) Halogenated organic solvents are hydrocarbons with one or more of the following halogens: fluorine, chlorine (e.g. trichloroethylene), bromine (e.g. n-propyl bromide) or iodine.
Emissions may be reduced even below the emission limit values of the SE Directive (see table 2) provided that only water-based systems are used.

For product groups requiring a high gloss effect, such as handbags and fashion products it is difficult to replace solvent-based top-coats and, if production levels are high, primary and/or secondary abatement measures may be required to reduce VOC emissions. Water-based systems for these product groups are, however, under development.

A further reduction of VOC emissions can be obtained by reducing solvent consumption using application techniques that reduce the thickness of coatings and thereby minimise material loss. Spray coating can achieve a thinner finish than roller or curtain coating. The VOC emission reduction achieved with spray coating is greatest when high-solid coatings and airless spray equipment are used - with optical detection of the product to be sprayed.

Appropriate handling and dosing of organic solvents (both for coating and for cleaning) can lead to a further reduction in solvent consumption.

Where primary measures are not sufficient to reduce the VOC emissions below the limit values, waste gas treatment systems may be necessary: biofilters and activated carbon filters are often used in the leather coating industry.

### 3 Description of the activity and related industry sectors

Leather coating is a process which is included within the ‘finishing’ stage of treatment at a tannery. When finishing, tanneries use a combination of processes including conditioning, staking, buffing, coating, milling, plating and embossing, in order to prepare leather for sale to the manufacturers of leather goods.

The objective of the finishing processes is to improve the appearance and properties of the leather. Depending on the intended purpose and the desired colour fastness properties, leather is finished with up to three or four coats: base-coat, intermediate coat, top-coat, and in some cases an additional coat for a special surface texture.

A wide range of leather products is made - these include shoes, furniture, automotive upholstery, clothing, bags, purses and belts.

The most important user of EU leather production is the footwear industry (50 %). The clothing industry takes about 20 %, leather for furniture and automotive upholstery about 17 %, and small leather goods compose about 13 % of the production. [BREF TAN 2003]

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4 Cross-linking agents promote or regulate the bonding between polymer chains to create a more rigid structure.

5 wt.-%: abbreviation for "weight percent"
In the EU-15, approximately 3000 companies produce 25% of the world's leather, manufacturing around 74,000 tonnes of heavy leather and 240 Mio m² of light leather. With 2,400 companies, Italy is the most important European producer of leather - accounting (in EU-15) for 65% of production; Spain has ~ 255 companies, Greece ~ 150, France ~ 113, Portugal ~ 100, UK ~ 55, and Germany ~ 37. [BREF TAN 2003]

The sector is dominated by small and medium sized enterprises: 90% of the companies employ less than 20 employees, 8.5% employ 21 - 100 people. About 30 companies (1%) in EU-15 employ 101 - 200 people and no more than 10 companies more than 200 people. [BREF TAN 2003]

In 2006, 12 Member States of EU-15 reported an estimated number of 32 leather coating installations falling into the scope of the SE Directive (missing data of Belgium, Italy and Sweden). [Implementation 2006]

4 Technical process description

The type of coating materials used has a key influence on the magnitude of VOC emissions; both conventional solvent-based systems and water-based systems are commonly used.

4.1 Process flow and relevant associated VOC emissions

Figure 1 gives a schematic overview of the process steps and possible VOC emissions from conventional solvent-based spray coating.
4.2 Application systems

The finishing materials used depend on the properties that the customer requires the leather to have. These may include protective coatings to preserve leather (and its colour) when it is subject to wet-rubbing and wet-flexing, to maintain a particular look, or to keep an attractive fashion effect or texture.

The industry uses a wide range of application techniques to achieve the desired finish. Roller coating, curtain coating and spray coating are the most commonly used coating systems; other techniques are foam coating, padding, brushing and transfer coating (transfer of a foil previously treated with adhesive).

Padding is a manual process but all the other techniques can be applied either manually or automatically. Automatic techniques are only used by the biggest tanneries because of the investment cost; these range from ~60,000 – 100,000 Euros for ~125 hides per hour. [BREF TAN 2003]

Curtain and roller coating are currently more effective (10 % waste) than spray coating (40 – 60 % waste) whereas the latter allows about double the throughput per hour. [BREF TAN 2003]

Table 3 shows the different coating techniques with their characteristics and alternatives.
Table 3: Leather coating techniques and their implications

<table>
<thead>
<tr>
<th>Method</th>
<th>Practice</th>
<th>Application range i.a.</th>
<th>VOC</th>
<th>Alternative</th>
<th>Waste</th>
<th>Cross media effects</th>
<th>Cleanliness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Padding/brushing</td>
<td>The finishing material is padded or brushed onto the leathers surface</td>
<td>Small leather goods with special look and effects</td>
<td>VOC based lacquers and finishing mixtures (3% - 8%)</td>
<td>None when these methods are required to create a special look</td>
<td>Overspray - may be reduced by using computer based spray coating, which improves spraying efficiency up to 75% (from 30%)</td>
<td>Cross-linking agents: isocyanides</td>
<td>Varies: water</td>
</tr>
<tr>
<td>Spray coating</td>
<td>Generally computer based in spray cabinets. HVLP spray guns and airless spray guns.</td>
<td>Thin and plain top coats</td>
<td>Mainly VOC-free or low VOC content mixtures (2% - 8%).</td>
<td>Depending on the requirement: Roller coating</td>
<td>Very precise coating. Therefore almost no waste such as overspray. The coat is heavier than applied through spray coating.</td>
<td>Water</td>
<td>Varies: water</td>
</tr>
<tr>
<td>Roller coating</td>
<td>Roller coating applies the finishing mix to the surface using rollers</td>
<td>Especially (not exclusively) for coating large pieces of leather. Used for car seats, upholstery and shoe leather. May be used for special surface effects.</td>
<td>VOC-free or low VOC content mixtures (2% - 8%).</td>
<td>Depending on the requirements: Curtain coating</td>
<td>Can be compared to roller coating. Can NOT be used as a substitute for spray coating</td>
<td>None</td>
<td>Variations in water content</td>
</tr>
<tr>
<td>Curtain coating</td>
<td>The leather passes through a curtain of finishing material</td>
<td>For heavy finish leathers only.</td>
<td>Finishes with a high VOC content (80 – 90 %)</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer coating</td>
<td>Coating from a continuous foil/film</td>
<td>For upgrading poor quality leather and splits. Also for special surface effects.</td>
<td>VOC free</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam coating</td>
<td>A thick film of foam is applied onto the surface</td>
<td>For buffed and impregnated leather. Useful when thick surfaces are required. Often applied on car seats and upholstery.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 5 Solvent use, emissions and environmental impact

#### 5.1 Solvent use

The basic components of leather coatings are binders, lacquers, colouring agents, solvents (organic substances, water) and additives (surface active substances, waxes, oils, cross-linking agents for water-based systems and other chemicals).

Various resin types can be used as binders e.g. acrylics, butadienes, polyurethanes and vinyl acetates. Solvent based resins are used for special effect coatings and to achieve particular requirements (for example, to preserve the appearance of leather which is subject to wet-rubbing and wet-flexing or to increase the permeability of the leather). The most commonly used binders are water-based resins (purchased as powder or dissolved in sodium hydroxide and other chemicals).

Lacquers may consist of nitrocellulose dissolved in organic solvents or polyurethane in water-based systems. Colouring agents are organic and inorganic pigments, dissolved in the particular coating systems (water or solvent-based).

The main solvents are water and organic hydrocarbons; these are used as carriers to create suspensions or dispersions of binders.

Conventional solvent-based systems contain between 80 – 90 % VOC while reduced organic solvent systems (e.g. water dilatable lacquer emulsions) contain ~40 % VOC.

Water based systems can contain 0 - 15 % organic solvents (e.g. ethyl acetate) but most commonly used water-based lacquers contain 5 – 8 % VOC.

Organic solvents are also used to adjust viscosity (e.g. methoxypropanol, isopropanol) and for equipment cleaning (using similar solvents as those used for dispersion and viscosity adjustment).

Organic solvents can be found in surface-active substances and cross-linking agents (both organic substances). Cross-linking agents usually contain 20 -50 % VOC.

Examples of cross-linking agents are [BREF STS 2003, p. 43f, 87, 94]:
- Poly-isocyanides, carbodiimides for polyurethane base- and top-coats
- Poly-aziridines for base-coats and top-coats
- Epoxies for top-coats
- Formaldehyde for casein and protein finishes

<table>
<thead>
<tr>
<th>Padding/ brushing</th>
<th>Spray coating</th>
<th>Roller coating</th>
<th>Curtain coating</th>
<th>Transfer coating</th>
<th>Foam coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>ning</td>
<td>water up to high VOC content mixtures.</td>
<td>up to high VOC content mixtures.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[BREF TAN 2003], [Ökopol 2008]
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- Ethylene-imine-based\(^6\) cross-linking agents for top-finishes
- Metal oxides for butadiene finishes for splits\(^7\).

Table 4 shows some of the organic solvents used for leather coating.

**Table 4: Examples of organic solvents used for leather coating**

<table>
<thead>
<tr>
<th>Hydrocarbons</th>
<th>Ketones</th>
<th>Alcohols</th>
<th>Esters</th>
<th>Glycol Ethers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylene</td>
<td>Acetone</td>
<td>Methanol</td>
<td>Isopropyl acetate</td>
<td>2-Ethoxy-ethanol</td>
</tr>
<tr>
<td>Toluene</td>
<td>Methyl ethyl ketone</td>
<td>Ethanol</td>
<td>n-Butyl acetate</td>
<td>2-Butoxy-ethanol</td>
</tr>
<tr>
<td></td>
<td>Methyl isobutyl ketone</td>
<td>n-Propanol</td>
<td>Ethyl acetate</td>
<td>2-Ethoxyethyl acetate</td>
</tr>
<tr>
<td></td>
<td>Cyclohexanone</td>
<td>Isopropanol</td>
<td>n-Propyl acetate</td>
<td>2-Butoxyethyl acetate</td>
</tr>
<tr>
<td></td>
<td>Di-iso-butyl ketone</td>
<td>n-Butanol</td>
<td>n-Amyl acetate</td>
<td>1-Methoxy-2-Propanol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1-Methoxy-2-Propyl acetate</td>
</tr>
</tbody>
</table>

[BTREF STS 2003, p. 36]

5.2 Solvent consumption and emission levels

The quantity of coating material applied can range from 0.2 g/m\(^2\) up to 400 g/m\(^2\). [BTREF TAN 2003, page “iii”]

In Austria, as the result of an increasing application of water-based technologies, VOC-free top coats and use of roller coating, every tannery can achieve emission levels ≤ 35 mg VOC per square meter of produced leather. [BTREF TAN 2003, pages 38/39]

The VOC consumption and any associated emissions depend on the type of product produced and the extent to which it is possible to substitute water-based coating systems for solvent-based systems. For additional VOC reduction, some producers have installed waste gas treatment systems (biofilters).

Table 5 shows illustrative data on solvent consumption and emission levels of three production lines using predominantly water-based systems. Two of the producers do not fall under the SE Directive because they have a solvent consumption of less than 10 tonnes per year.

Small amounts of solvent-based coatings are still used. The figures of the third producer show a high total VOC emission per m\(^2\) of product, for those products where solvent-based systems were applied.

6 Ethylene-imine is toxic and carcinogenic  
7 Splits are pieces of leather obtained by splitting the hides and skins horizontally
Table 5: Examples of VOC consumption and emission levels of leather coating

<table>
<thead>
<tr>
<th>Type of products</th>
<th>Annual production of coated leather</th>
<th>Annual VOC consumption</th>
<th>VOC emission per m² product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car leather, furnishing</td>
<td>&gt; 2,000,000 m²/a</td>
<td>&gt; 10 t</td>
<td>7.5 g/m²</td>
</tr>
<tr>
<td>Furnishing</td>
<td>&gt; 500,000 m²/a</td>
<td>&lt; 1 t</td>
<td>0.9 g/m² (related to total production)</td>
</tr>
<tr>
<td>Thereof coated with solvent-based system: ~ 100,000 m²/a</td>
<td></td>
<td></td>
<td>4.5 g/m² (on products coated with solvent-based systems)</td>
</tr>
<tr>
<td>Car leather, shoe leather, furnishing</td>
<td>&gt; 2,500,000 m²/a</td>
<td>&lt; 1 t</td>
<td>~0.25 g/m²</td>
</tr>
<tr>
<td>Thereof coated with solvent-based system: ~ 3000 m²/a</td>
<td></td>
<td></td>
<td>222 g/m²</td>
</tr>
</tbody>
</table>

[Ökopol 2008]

5.3 **Key environmental and health issues**

In leather coating activities a broad range of different solvents is used, mainly when applying coating systems containing organic substances and when cleaning equipment.

Process emissions of solvents, together with NOx emissions, are precursors of ground level ozone formation in the presence of sunlight. Existing occupational workplace limits should be taken into consideration.

Emissions of VOC to air may occur from:

- the storage of the solvents
- the process
- cleaning operations

Spills and leaks from storage areas may result in emissions to soil and groundwater.

In leather coating toluene may be used as solvent of coatings. It is classified with the risk phrase R40, providing limited evidence of carcinogenic effect. In cases where the mass flow is > 100 g/h, the SE Directive sets specific emission limit values (see section 1).
6 VOC substitution

The following sections describe potential substitutes for VOC (using VOC-free and VOC-reduced systems). There are also descriptions of the application technologies or special conditions needed and the advantages and disadvantages compared to systems that use solvents with a high VOC content.

In general, substitution of VOC emissions from leather coating activities can be achieved by:

- Substitution of solvent-based coatings by VOC-free water-based coating systems
- Use of VOC-free cleaners

6.1 VOC-free systems

This section describes the ways that VOC-free products or systems can be used to replace the organic solvents currently used.

6.1.1 Substitution of solvent-based coatings by VOC-free water-based coating systems

For tanneries, the 2003 BREF document defined the following as best available techniques (BAT) for leather finishing when organic solvents are used [BREF TAN 2003, p. 168]:

- Substitution with water-based finishing systems. Exception: if very high standards of topcoat resistance to wet-rubbing, wet-flexing and permeability for perspiration are required.
- Substitution with low-organic solvent-based finishing systems.
- Use of systems with low content of aromatic organic solvents.

VOC-free water-based coatings are available for a wide range of products and customer requirements. They can be applied to most leather products.

It should be noted, however, that some water-based substitutes for solvent-based systems may not be able to achieve fully equivalent properties of topcoat resistance to wet-rubbing, wet-flexing and permeability for perspiration, UV resistance, and colour conservation e.g. for upholstery for automotive and furniture.

Similarly, special effect lacquers for fashion articles are often only produced as solvent-based systems (e.g. for shoes, bags, clothing etc - mainly produced in southern Europe).

Organic solvents reduce the surface tension of water thus giving the finish improved flow properties. In contrast, VOC-free coatings have poor flow properties; consequently droplets may form on the leather.

Coating systems have been developed to improve these characteristics (polyurethane dispersions and acrylic emulsions as well as hybrid acrylic polyurethane polymers).
There are water-based products on the market that do not contain cross-linking agents but are self-linking and consequently do not cause VOC emissions.

6.1.2 Use of VOC-free cleaning agents

Dry ice (CO$_2$) can be used for routine machine cleaning. If water-based systems are used VOC-free cleaning agents can be applied.

6.2 VOC-reduced systems

If the complete substitution of organic solvents is impractical then changing to systems with a reduced VOC content, such as those described in this section, can decrease emissions.

6.2.2 Substitution of solvent-based systems and reduction of VOC content of coating systems

For some lacquers, it may be possible to substitute conventional products (80 – 90 % solvent content) with VOC-reduced systems that contain ~40 % organic solvents (water dilatable). Water-based coating systems are able to meet most product requirements.

The solvent in water based systems is partly added to control the viscosity of the coating (0 - 15 % organic solvents is added for this purpose) and is partly present as a result of being used in the cross-linking agents that are added to the water-based coatings. Different types of cross-linking agent are available and the VOC content ranges from 20 to 50 % VOC reductions can be achieved by using products with lower VOC content.

Cross-media effects

When using low-organic solvent systems and water-based systems, the toxicity of the cross-linking agents used in the coating polymers needed to achieve acceptable leather characteristics can present workplace safety problems. Safety data sheets and national regulations need to be taken into consideration.

A further cross-media effect is the higher energy consumption for drying water-based top-coats. [BREF TAN 2003, page 95]
7 Other VOC emission prevention measures and abatement techniques

Preventative measures, process improvements and abatement techniques can be used to reduce VOC emissions if VOC substitution as described in section 6 is not possible. The following measures can be applied for leather coating:

- Improved solvent handling when preparing coatings
- Reduction of VOC emissions from cleaning of coating equipment (improved solvent handling)
- Increased coating efficiency (by reducing overspray)
- Installation of abatement systems

7.1 Process improvement

To minimize costs and to save resources, coating layers should be as thin as possible while still meeting product requirements; improving the efficiency of the coating application also reduces VOC emissions. The following coating techniques can be selected to reduce overspray (exception: conventional spray coating has to be used if very thin coatings e.g. on aniline and aniline-type leather have to be applied) [BREF TAN 2003, p. 170]:

- Roller coating
- Curtain coating
- HVLP spraying
- Airless spraying

7.2 Waste gas abatement

Achieving the VOC total emission values required by the SE Directive may be difficult if solvent-based systems cannot be avoided. In these cases untreated organic solvent emissions from the finishing process may vary between 800 and 3,500 mg/m³. Approximately 50 % of VOC emissions arise from spray-finishing machines, and the remaining 50 percent from dryers. [World Bank 2007]

In such cases, waste gas abatement is likely to be required. Depending on the VOC concentration in waste gases, thermal oxidisation, adsorption and treatment with biofilters may be used. [World Bank 2007]

In the case of biofilters, VOC reduction efficiencies of 50 – 65 % have been reported from the leather industry. [Ökopol 2008]
## 8 Summary of VOC emission reduction measures

The following table summarizes the various approaches to reduce VOC emissions that are described in chapters 6 and 7:

Table 6: Measures for VOC substitution and VOC reduction in leather coating

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOC-free Systems</strong></td>
<td></td>
</tr>
<tr>
<td>Substitution of solvent-based coating systems</td>
<td>Use of VOC-free water-based coating systems with VOC-free cross-linking agents or with self-linking substances</td>
</tr>
<tr>
<td>Substitution of solvent-based cleaners</td>
<td>Use of water-based cleaners</td>
</tr>
<tr>
<td><strong>VOC-reduced Systems</strong></td>
<td></td>
</tr>
<tr>
<td>Reduction of the VOC content in coating systems</td>
<td>Use of solvent-based systems with reduced VOC content</td>
</tr>
<tr>
<td></td>
<td>Use of water-based systems with low content of organic solvents</td>
</tr>
<tr>
<td><strong>Process Improvements</strong></td>
<td></td>
</tr>
<tr>
<td>Use of more efficient application techniques</td>
<td>Roller coating</td>
</tr>
<tr>
<td></td>
<td>Curtain coating</td>
</tr>
<tr>
<td></td>
<td>HVLP spraying</td>
</tr>
<tr>
<td></td>
<td>Airless spraying</td>
</tr>
<tr>
<td>Reduction of VOC emissions from cleaning</td>
<td>Improved handling (in particular when storing, barrel pumping, mixing)</td>
</tr>
<tr>
<td><strong>Abatement Technologies</strong></td>
<td></td>
</tr>
<tr>
<td>VOC destruction</td>
<td>Thermal oxidation</td>
</tr>
<tr>
<td></td>
<td>Biofilters</td>
</tr>
<tr>
<td>VOC adsorption for later destruction or recovery</td>
<td>Activated carbon</td>
</tr>
</tbody>
</table>
9 Practical examples

9.1 Swedish case

A Swedish producer of leather for upholstery and automotive applications has abandoned its traditional solvent-based systems in favour of exclusively water-based coatings. Since these have a VOC component the water effluent from the overspray water curtain is treated with a mechanical biological treatment system.

The VOC content of the water-based coating systems is continuously assessed to identify further opportunities to reduce the VOC content.

Prior to these VOC reduction initiatives, the VOC emission was about 180 g/m² of finished product, after their introduction emissions reduced to 6 – 10 g/m².

[ELMO 2008]

9.2 Italian case

An Italian company specializing in the production of cattle-hide leather for upholstery and automobile products has introduced a finishing plant with a substantially improved spraying system and has achieved a significant reduction in its VOC emissions.

The coating machine consists of a spray booth, fed by conveyor belt, and equipped with three innovative oscillating spray bars - these are transverse to the feed direction. Each spray bar has 100 airbrush spray guns in line, equipped with micro pressure nozzles. Each oscillating bar has double circuits for the coatings, special conduits for compressed air, and electric valves to control the nozzles.

The bars can easily be dismantled into 5 pieces that can be cleaned, automatically, in an hermetically sealed tank.

[ELMO 2008]

Figure 3: Conveyor belt spraying booth and oscillating bars with spray gun nozzles

The plant is equipped with an optical detector bar at the input side of the booth that transmits command signals to the three spray bars. Depending on the feed rate, a process controller calculates the time necessary for the hide to reach the three bars. This allows openings at the input side of only 2 cm which reduces VOC emissions to the workplace.
The system uses an atomization pressure 30 times less than that of traditional guns and 10 times less than HVLP spray guns.

The use of reduced pressure and 'fixed' guns reduces overspray - the spray efficiency reaches 94 - 96 % compared to 15 - 35 % in conventional rotary spray gun booths. Overall the use of coating material and related VOC emissions is reduced by up to 35 %.

Additional benefits are a higher particle scrubbing efficiency compared with common particle scrubbers that operate at a high air flowrate and seldom exceed 90 % efficiency. The booth can operate without a water curtain on the side walls, saving water and pump energy as well as reducing waste. The system is significantly less noisy too; this is due to the lower airflow for particle scrubbing, reduced air pressure for atomization and the elimination of the spray pistol carousel.

The system achieves a uniform spraying quality that otherwise would be difficult to obtain. The low pressure and almost vertical spray direction allows the use of natural dyes. The technique allows the conveyor speed to be increased by 40 %.

[SICA 2008]

10 Emerging techniques

Electrostatic spraying

In the Reference document on best available techniques for the tanning of hides and skins [BREF TAN 2003], electrostatic spraying is referred to as an emerging technique for leather coating.

Electrostatic spraying technique is applicable, but only if both the coating material and the coated object can be electrically charged. As leather is not a conductor of electricity, this can only be achieved if the leather is sprayed while in contact with a piece of metal of the same shape; since hides are of different shapes and sizes this is a difficult condition to meet cost effectively.

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