FAILURE ANALYSIS ON COATINGS
IDENTIFYING AND PREVENTING COATING DEFECTS – WE CAN HELP!

Identify the cause

The reasons for defects on decorative and functional coatings can be highly diverse, for example deficiencies in the curing process, incorrect mixing ratio of a two-component coating system, contamination by substances impairing wetting, the inclusion of foreign particles or defects in the substrate. In some cases, at least two unintentional changes of the system can occur simultaneously. On their own, these would not cause any damage, but in combination they can be responsible for major failures. Since the reason for the defect in each case is unique, a tailored approach to troubleshooting is required.

Take corrective action

Despite high quality standards in paint shops and carefully monitoring raw materials, coating defects are nevertheless observed again and again. This leads to high reject rates, sometimes resulting in compensation payments and a loss of customer trust. In such cases, fast and effective remedial action needs to be taken. Our team will gladly assist you, drawing on a wealth of expertise in chemical and physical analysis as well as in painting processes. In personal discussions with our customers, we work together to identify failure patterns and develop individual solutions to rectify the problem.

Ensure quality

Once a problem has been identified and remedial action taken, appropriate quality control measures must be implemented to avoid similar errors in the future.
OUR APPROACH

Personal discussion with presentation of the overall process and assessment of defects (visual appearance, failure rate, etc.)

Non-Disclosure Agreement (if desired)

Individual offer with a choice of suitable analysis methods, if necessary with on-site process analysis and sampling anywhere in the world

Conclusion of contract

Fast processing, constant transfer of results

Corrective measures recommended

Process support during implementation of corrective action

Production support through subsequent quality control
## EXAMPLES OF FAILURE ANALYSIS

<table>
<thead>
<tr>
<th>Defect</th>
<th>Analysis</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delamination of a UV coating</td>
<td>The UV-cured coating can be simply removed from the substrate with a tape without any further force being required.</td>
<td>Some UV lamps were replaced, although the replacement lamps were not ideally suited to the UV coating. Suitable radiation sources must be used for the curing process to avoid adhesion failures.</td>
</tr>
<tr>
<td>Imprint marks on varnish</td>
<td>The varnish is much softer than usual and tends to show imprint marks on applying light pressure.</td>
<td>The 2-component mixing process was set incorrectly and required adjustment. Analytical checks during the process ensure the right mixing ratio.</td>
</tr>
<tr>
<td>Delamination of zinc powder paint</td>
<td>Large quantities of zinc powder paint flake off from a piece of manufacturing equipment and impair the production process.</td>
<td>Due to the thermal and chemical stress experienced by the manufacturing equipment, a more stable paint system is recommended.</td>
</tr>
<tr>
<td>Partial delamination of coating from the metal substrate</td>
<td>The coating appears to delaminate at random from solid metal parts.</td>
<td>The coating must be applied with the specified layer thickness and cured at an optimum temperature.</td>
</tr>
</tbody>
</table>
OUR KNOW-HOW

The focus of our work is on organic coatings, their material properties and fields of application. These range from coatings for wood, through wall paints, to functional and decorative paints for the automotive industry.

We specialize in dealing with the following coating defects (examples):

- Defects in substrates
- Delamination, poor adhesion
- Inadequate cleaning processes or surface contamination
- Insufficient substrate pretreatment
- Faulty curing conditions
- Incorrect mixing ratio of a 2-component system
- Contamination in paint materials and coatings
- Mechanical stress on coatings
- Environmental influences
- Typical coating defects, e.g. bubbles, craters, pinholes, particles, etc.

Our testing methods and techniques (examples):

- Infrared spectroscopy to analyze binders and fillers, detect surface contamination, infrared microscopy
- Thermal analysis (DSC, TGA, DMA, STA)
- GC-MS to analyze volatile components
- Determination of the surface energy of substrates (Sessile Drop) and paints (Pendant Drop)
- Laser scanning microscopy
- Scanning electron microscopy (SEM) with energy dispersive X-Ray spectroscopy (EDX), focused ion beam (FIB)
- Rheological investigations
- Raman spectroscopy
- Particle size distribution in paints
- Preparation of cross-sections of defects

Some of these methods are accredited according to DIN EN ISO/IEC 17025.
ANALYTICS AND MATERIALS TESTING

FAILURE ANALYSIS ON COATINGS
Dr. rer. nat. Katharina Weber  
Group Manager  
Analytics and Materials Testing  
Phone +49 711 970-3831  
katharina.weber@ipa.fraunhofer.de

Dr. Michael Hilt, MBA  
Head of Department  
Coating Systems and Painting Technology  
Phone +49 711 970-3820  
michael.hilt@ipa.fraunhofer.de

Fraunhofer Institute for  
Manufacturing Engineering and Automation IPA  
Allmandring 37  
70569 Stuttgart  
Germany  
www.ipa.fraunhofer.de

Directors  
Prof. Dr.-Ing. Fritz Klocke  
Prof. Dr.-Ing. Thomas Bauernhansl