# FFI

# Robust Polishing of environmentally friendly coatings and their dependence on the substrate for lightweight materials in the automotive industry

# FFI

## Content

### FFI in short

FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. FFI has R&D activities worth approx. €100 million per year, of which half is governmental funding. The background to the investment is that development within road transportation and Swedish automotive industry has big impact for growth. FFI will contribute to the following main goals: Reducing the environmental impact of transport, reducing the number killed and injured in traffic and Strengthening international competitiveness. Currently there are five collaboration programs: **Vehicle Development, Transport Efficiency, Vehicle and Traffic Safety, Energy & Environment and Sustainable Production Technology.**
**For more information:** www.vinnova.se/ffi

# 1. Executive summary

Assessment of surfaces and polishing of painted parts is a recurring problem. The assessment of polishing result is often subjective and varies between different actors. The pre study aims to result in a consensus regarding paint defects between the actors.

The objectives for the pre study were:

- Mapping the project partners' views on paint defects / polishing problems
- Compile how the project partners have worked with polishing and solved their problems
- Perform a state-of-the-art survey

The following project aim to develop test routines for coating systems, in order to secure final surface quality when new coating systems are introduced in production. The method shall be used to test and verify the polishability of coatings including an objective characterisation and estimation technique of the surface finish.

A project team was set up with participants from Volvo Car Corporation, Scania, Plastal, Becker Industrial Coating, Volvo Technology and Halmstad University.

Internal knowledge was shared within the team. Each project partner has giving their view on polishing, what problems they have experienced, how the problems have been resolved and what challenges they see ahead. This has been discussed and the knowledge summarized.

In addition to the compilation of internal knowledge an extensive literature search of the area was performed. A workshop/seminar was hold to which relevant external actors where invited.

All material has been summarized in a literature study and state-of-the-art report. In the report a chapter is dedicated future activities and objective with the main project.

# 2. Background

The project partners have a number of plants producing products that are painted with different paint materials and clearcoats. The paint material has different

properties regarding among others polishability, i.e. easiness to polish a surface to a certain finish and achievable surface quality. This means that it is of high importance to have knowledge in the product development making it possible to make relevant and objective quality assessments with respect to surface finish before and after painting as well as the polishing procedure.

Polishability has become one of the key points to develop further since today surface finish is a measure of the cars' quality. One problem to overcome is that different actors have their own approach on describing and characterizing polishing problems. Similar problems are found in the entire automotive industry.

A robust method to test and verify the polishability of coatings, including an objective characterization and estimation technique for the surface finish, is expected to result in lead time shortening in the product development stage of new coatings. It would also mean considerable savings in terms of less implementation problems, e.g. with new paint material late in the developing process that turn out to be impossible to polish in production. This problem will increase in the future when the industry head towards lighter materials which leads to a material change.

# 3. Objective

Assessment of surfaces and polishing of painted parts is a recurring problem.

The assessment of polishing result is often subjective and varies between different actors. The pre study aims to result in a consensus regarding paint defects between the actors.

The objectives for the pre study where:
- Mapping the project partners' views on paint defects / polishing problems
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The following project aims to develop test routines for coating systems in order to secure final surface qualities when new coating systems are introduced in production. The method shall be used to test and verify the polishability of coatings including an objective characterisation and estimation technique of the surface finish.

# 4. Project realization

A project team was set up with participants from Volvo Car Corporation, Scania, Plastal, Becker Industrial Coating, Volvo Technology and Högskolan i Halmstad.

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# 5. Results and deliverables

Below is the introduction from the state-of-the-art report.

## 5.1 Introduction

The coating of the exterior bodies of cars and trucks has two major functions, to work as a protection layer and to give the vehicle the right appearance. Today automakers and their suppliers need to reduce their environmental impact, i.e. to introduce more environmentally friendly paint systems. Simultaneously, beside time and cost targets, they need to meet the requirements of extreme surface qualities, which for top coatings depend on various factors; the substrate, type of coating system/paint, application technology and drying conditions, achieved coating properties (e.g. thickness variations and occurrence of defects), and any repair processes.

This text focus on the last unwanted but necessary step in the end of the painting process – in-plant repairs of the coating. The main question is how a top coat should be repaired by abrasive polishing (MANU polishing) in order to achieve the same surface quality appearance (FUNC) as the non-repaired surrounding surface areas. Figure 1 illustrates the included process steps; MANU-painting since it define the initial surface condition, CHAR-inspection since it is where any defects are detected and the decisions are taken to repair an imperfection or not (i.e. to re-paint or reject the part), MANU-polishing is the repair process based on sanding and polishing strategies, FUNC defines the function of the coating.

Figure 1: Flow chart to illustrate the steps towards 'defect free' coatings; MANU – manufacturing, CHAR – characterization, and FUNC – function.

A step towards robust polishing is to define, and agree on, common estimation criterion for the appearance of surface finishes. Measurement device/s and analysis techniques should be used to support human inspections in order to secure that unwanted defect structures, mainly hologram effects, will be detected. Such system should also be helpful to tune the polishing process so that proper strategies are used, i.e. to be able to detect defect structures in their early stages. It is also of great importance to better understand the polishing mechanisms to be able to develop sufficient polishing strategies for new coating systems, and to set up and describe these strategies for the workers.

References will be presented in conjunction to each chapter; internal knowledge, experience, comments etc. are summarised in a project specific sub-chapter (i.e. Project spec. – name of the chapter).

### 5.1.1. Aim

To survey the state-of-the art in top coating factory repair (i.e. abrasive polishing) of OEM (original equipment manufacturer) and Tier1 parts, including:

- internal competence (knowledge, practice and problems)

- selected actors within the field.

### 5.1.2. Limitations

Other reparation techniques like spot-repair will not be included. Newer surface structures, like matte finishes or self-healing coatings, will only be briefly discussed

# 6. Conclusions and future research

Polishing problems are normally arising late when a new paint concept is introduced, and the polishability of coatings is not fully understood. Most knowledge is kept inside companies (not officially published), and is built up by trial-and-error tests based on long experience within the field. Further, surface appearance is commonly based on subjective estimations leading to large variations of the final surface quality.

The aim of the next-coming project (part 2) is to develop test routines for coating systems, in order to secure final surface quality when new coating systems are introduced in production. The method shall be used to test and verify the polishability of coatings including an objective characterisation and estimation technique of the surface finish.

The possibilities to systematically test coating systems are expected to result in a better understanding of polishing mechanisms and what factors are the most influencing ones for the tribo-system. Further, the problems with new coating concepts in production will be reduced and the dependence of suppliers' 'blackbox solutions' will decrease. A first version of a polishing-rig developed at Volvo Cars has been successfully used to test and evaluate different polishing strategies for clear coats .The WMS well as other measurement equipment (e.g. interferometry) will be available and used in order to estimate surface appearance and study scratch patterns and other polishing defects in more detail.



*The polishing-rig developed at Volvo Cars where different clear coats and polishing strategies can be tested in a systematic way.*

# 7. Participating parties and contact person

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