DSM Carbon Footprint Study for Industrial Coatings Applied on a Metal Substrate
Climate change continues, and worldwide efforts to confront climate change continue as well. It is one of the biggest challenges facing industries, governments and society.

Policy makers and industry sectors across the world are working to understand their role and required actions. Individual chemical companies are already pulling their weight in the area of energy efficiency and innovation, recognizing environmental performance – alongside health, safety and security – as essential to business success.

To identify how we can improve the performance of the coating industry and what impact the choice of coating system has, we must first understand its current carbon footprint (based on raw materials consumed and energy spent during manufacture and application, and transferred to CO2 emissions). DSM has taken the initiative to develop a common understanding of how this can be calculated. Along with related issues and challenges, individual companies will now be able to assess themselves in a way that is comparable across the industry. In the end this will empower the whole industry to make the right choices.

For many years users have enjoyed the economic and technical benefits of powder coatings. Very early, it was intuitively understood that powder coatings are the coating system with a relatively low carbon footprint. This was, however, never supported by a comprehensive analysis taking account of all elements involved in the coating process. DSM now has undertaken this step in order to underpin the prevailing view.

We proudly present our Carbon Footprint Study for industrial coatings on metal substrates. The outcomes of the carbon footprint calculations for the various coating systems have been validated by an independent third party. Outcomes which confirm that water borne coatings and powder coatings produce the lowest carbon footprint.

By far the most effective opportunity to further reduce the carbon footprint of powder coatings lies in the reduction of layer thickness, followed by epoxy/hybrid replacement and lowering of curing temperatures. DSM is investing substantially in all three areas of innovation and will continue to do so.

In our efforts to reduce the carbon footprint of our powder coating systems, we want to take the industry one step further. Our intention is to invest in new systems for new application areas including substrates that go beyond the traditional metal substrates, such as wood and plastics. Working in close partnership with our customers, we aim to help Shaping the Powder Coating Industry as a whole, by providing sustainable solutions for the future.

Climate change is not only a challenge, but an opportunity. A paradigm shift to a low-carbon economy can potentially drive forward a new era of technological innovation. It will require a third - this time green - industrial revolution. To realize that potential the new framework must harness the power of the market to deliver our environmental objectives. We trust this study is a first step of a long successful journey towards a strong, profitable, and sustainable Coating Industry.
DSM Powder Coating Resins

DSM and its History

DSM has a long history of transformation. From the beginning in 1902, when the Dutch government formed the state-owned coal company, to today’s DSM: a Life Sciences and Materials Sciences company.

- At a very early stage, DSM realized the need for change. In the 1930s it converted a by-product from coal mining into a profitable commodity, ammonia, a key raw material for nitrogenous fertilizers.
- By 1970, chemicals and fertilizers comprised the company’s main activity, accounting for two-thirds of its turnover. Petrochemicals then took centre stage.
- In 1989 DSM was privatized and its shares were floated on the stock exchange.
- Over the past 12 years major portfolio changes have taken place, such as the divestment of the petrochemicals business and the acquisition of the vitamins business. With the divestment of the base chemicals activities in recent years and the changes within the organization, DSM is now ready for the next growth phase.
- In this next phase DSM will deliver on its promise of creating brighter lives for people, driving focused growth, and becoming a truly global company.

About DSM

Royal DSM N.V. creates solutions that nourish, protect and improve performance. The company creates products and services in Life Sciences and Material Sciences.

Its end markets include human and animal nutrition and health, personal care, pharmaceuticals, automotive, coatings and paint, electrical and electronics, life protection and housing.

DSM manages its business with a focus on the triple bottom line of economic performance, environmental quality and social responsibility, which it pursues simultaneously and in parallel.
We all know that climate change is a reality, and that energy is a central challenge for society both in terms of how to create it, and how to get the most out of it. Today the industry as a whole is seeking sustainable value chains with higher yields, reduced waste, lower energy use, and fewer GHG (Green House Gas) emissions.

Our world is facing serious challenges.

If current consumption continues, we will need 2 globes by 2040(*)

- Growing world population
- Resource constraints: scarcity of food, land, materials
- Carbon constraints
- Over exploitation of global eco-system

* Source: WWF, Living Planet Report October 2008

 DSM and Climate & Energy

We all know that climate change is a reality, and that energy is a central challenge for society both in terms of how to create it, and how to get the most out of it. Today the industry as a whole is seeking sustainable value chains with higher yields, reduced waste, lower energy use, and fewer GHG (Green House Gas) emissions.
DSM’s Focus on Planet

The Planet element of our sustainability strategy is essentially about caring for the environment. Here is how we work towards greater sustainability in the Planet field:

- by performing studies to understand the eco-footprint of our products
- by developing solutions that reduce eco-footprints throughout the value chains in which we operate.
- by continuously improving our own eco-footprint, for example, by using energy and raw materials efficiently and using renewable resources where possible;

DSM Makes Sustainability part of its Strategy

DSM believes that the implications of sustainability are so profound there is simply no future for a modern business which does not embrace a Triple P based approach to doing business. DSM believes sustainability will become the key business value driver and differentiator for companies worldwide and DSM has a unique opportunity to address and capitalize on this development.

The DSM in motion: driving focused growth strategy is based on addressing unmet needs in relation to Global Shifts, Climate and Energy and Health and Wellness, the major global trends.

To reach this next level DSM is building on its internal value and Triple P driven approach by making sustainability a primary business driver for all its activities. This means embedding Triple P more fully into its organization and activities, tapping the creativity of its increasingly global and diverse organization and pursuing its Triple P objectives in a simultaneous and balanced way.
DSM and LCA Studies

Life Cycle Assessment may be used for various purposes. Traditional LCAs target relative scores for a range of options to be compared. The outcome of such a study, in principle, is that “A is better than B within the context of this Study”. In order to ensure that such claims carry validity in a general sense, the ISO guidelines prescribe an expert review if the claim is to be made public.

Today it is increasingly common to use so-called “footprint” information in B2B down the value chain negotiations. Footprints give an absolute score for a certain product within a standard methodology framework. One such framework is the British PAS2050, a commonly recognized set of rules for carbon footprint of products, e.g. for use in B2C labelling.

DSM aims at Innovative and Sustainable Coating Solutions

Among the many other areas in which DSM is involved, DSM is looking to develop sustainable solutions within the coating industry.

DSM has investigated the carbon footprint of the production and application of powder coating systems in comparison with typical liquid coating systems. This report presents the results of its investigations for selected powder, solvent and water borne coatings.
The study covers the analysis of 11 coating formulations applied to 1 m² of steel substrate. Coatings included:

1. Powder coatings for interior and exterior use
2. Water borne industrial alkyd coatings and
3. Solvent borne polyester and acrylic based high solids coatings

While the focus of this report is primarily on the carbon footprint of each of the examined coating systems, other environmental impacts will be presented in the study to expose the overall eco-footprint.
Assumptions:

<table>
<thead>
<tr>
<th>Components</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Metal</td>
<td>Surface: 1 m², flat, Thickness: 1mm</td>
</tr>
<tr>
<td>Coating</td>
<td>TiO₂ based white coating</td>
</tr>
<tr>
<td>Carbon Footprint Resin Technology</td>
<td>Assumed to be equal for all paints</td>
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<tr>
<td>Pigment / Resin Ratio</td>
<td>Dependent on product formulation</td>
</tr>
<tr>
<td>Curing Temperature</td>
<td>180°C Powder (Unilac® EasyCure™ at 190°C) 150°C others</td>
</tr>
<tr>
<td>Layer Thickness</td>
<td>40µ-50µ Powder, 30µ others</td>
</tr>
<tr>
<td>Overspray</td>
<td>6% Powder, 35% for Solvent-borne and Water-borne</td>
</tr>
<tr>
<td>Drying Temperature</td>
<td>As defined per paint</td>
</tr>
<tr>
<td>Solvent Treatment</td>
<td>Incineration</td>
</tr>
<tr>
<td>Durability / Functionality</td>
<td>No differentiation</td>
</tr>
</tbody>
</table>

**Components of this LCA Analysis of Coatings:**

- The substrate is 1m² of 1mm thick steel.¹
- The impacts of the energy required to evaporate solvents and water
- The impacts of the energy required for substrate heating
- The impacts of the energy required to heat the process air *
- The CO₂ emissions from solvent incineration**

¹: Specific weight of steel 7800kg/m³, specific heat capacity of steel 438kJ/kg°C.
* - *** for more details please refer to a full report that is available upon request.
More than One Sustainable Solution

There are massive opportunities to reduce CO2 emissions by replacing solvent borne coatings with powder coatings and or water borne paints.

The Results

For many years users have enjoyed the economic and technical benefits of powder coatings. Early on it was already intuitively understood that among all coating solutions, powder coatings have a relatively low carbon footprint.

This study confirms that water borne and powder coatings have the lowest carbon footprint when industrially applied on a metal substrate.

DSM requested CE Delft to assess the conformity of this study with PAS2050 guidelines.

CE Delft confirmed that the Carbon Footprint Study had been performed with care and with comprehensive coverage of inputs and outputs of DSM processes. Completeness is estimated at 97% and is PAS2050 compliant.
Powder Coatings Can Help Reduce CO2 Emissions

Solvent borne coatings have a higher carbon footprint than powder coatings as they typically require more paint to obtain equivalent coverage, and more energy for solvent evaporation and air heating.

Reducing Green House Gas Emissions by Switching Coating Systems

We can protect the environment by lessening our CO2 emissions by up to the equivalent of 9.5 million cars or average annual carbon footprint of 1.5 million people.
DSM innovates to make Powder Coatings even more sustainable.

THE STUDY - CO₂ emissions:
The Innovation efforts of DSM in Powder Coating Resins are mainly based on:

Reducing Layer Thickness

Epoxy and Hybrid Replacement

Lowering Curing Temperatures

DSM in Powder Coating Resins works to develop resins that possess the properties that will help us reduce the Carbon Footprint of Powder Coatings even further.

DSM has confirmed the long-held hypothesis that Powder Coatings are among the most sustainable coating solutions.

Next to the economic and technical benefits of Powder Coatings, the hypothesis has long been that Powder Coating Systems very likely produce the lowest Carbon Footprint.

This is the first quantitative analysis to confirm that statement.

DSM's Innovation efforts in Powder Coatings

By far the most effective opportunity to reduce the carbon footprint of powder coatings is the reduction of layer thickness, followed by epoxy/hybrid replacement and lowering of curing temperatures. DSM is investing substantially in all three areas of innovation and will continue to do so.

Powder Coatings have Great Environmental Benefits

For many years users have enjoyed the economic and technical benefits of powder coatings. Very early it was intuitively understood that powder coatings are the coating system with a relatively low carbon footprint. Until now, this was never supported by a comprehensive analysis, taking into account all elements involved in the coating process. With this study DSM has demonstrated that powder coatings are among the most sustainable coating solutions.
Together We Can Reduce the Carbon Footprint!

The philosophy behind this initiative has been to take the powder coating value chain up to a higher level, and to underpin the sustainable character of this technology.

To identify ways in which we can improve the performance of the coating industry and the impact of the choice of coating system, we must first learn to understand the current carbon footprint. Along with related issues and challenges, other companies will from now on be able to assess themselves in a way that is comparable across the industry and that will help them make the right choices.

A copy of the study is available (at no charge) for all interested parties who wish to join us in Shaping the Powder Coating Industry.

For more information and a full report please go to [www.dsmpowdercoatingresins.com](http://www.dsmpowdercoatingresins.com) and select Sustainability page.