DSM Carbon Footprint Study for Industrial Coatings applied on a Metal Substrate
Introducing DSM:  
*DSM is everywhere*

- Located on five continents
- Approx. 22,700 employees
- Annual net sales of €8 billion
- No 1 in Dow Jones Sustainability World Index
- Winner of 2009 Outstanding Corporate Innovator Award

Royal DSM N.V. creates innovative products and services in Life Sciences and Materials Sciences that contribute to the quality of life.
DSM’s Ability to change: 
100 years of successful transformation
DSM and the Dow Jones Sustainability Index:

DSM is the No. 1 player in the chemicals market sector of the Dow Jones Sustainability Index

DSM takes responsibility for the Environment:

• As a company
• With the products it makes

DSM Sustainability Awards
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
Climate Change and Global Warming force society to think and act differently.

Sustainability has never been more relevant than today!

Policy makers and industry sectors across the world are working to understand their role and required actions.

Chemical companies are aligning their innovation efforts to energy efficiency and overall environmental impact.

* Source: WWF, Living Planet Report October 2008
Many companies have already integrated Sustainability into their strategy. So has DSM.

- Sustainability embedded in the company
- The eco-footprint throughout the value chain
- Leader in White Biotechnology
- Diverse workforce
- Responsible partner in society

DSM’s sustainability is an integral part of its strategy
DSM conducts LCA* studies to maintain its high-level of commitment to Sustainability.

DSM LCA* methodology:

- SimaPro and EcolInvent database for environmental impact data
- Eco Indicator 99 for total Eco impact
- IPPC GWP 2007 for Carbon Footprint
- Own department for executing LCA
- Working with independent 3rd parties

* Life Cycle Assessment
DSM’s Innovation Targets: sustainable coating solutions

Coatings are all around us.

Within DSM’s Performance Materials cluster, the focus on innovation includes sustainable coatings solutions.

But how well, really, do we know how much impact any coating has on the Carbon Footprint?
DSM has conducted an LCA study for Industrial Coating systems.

This LCA determines the Carbon Footprint of the resin and coating manufacturing process and the application of the coating on metal, and defines the CO\textsubscript{2} emission of coating applied on 1 m\textsuperscript{2} metal.

This study* includes:

- Resin production (both raw materials and energy)
- Coating production (both raw materials and energy)
- Coating application (solvent addition and energy)

* Note: The study was verified and it results validated by CE Delft, an independent and objective third party, in conformity with PAS2050 Carbon Footprinting standards.
The coating formulations covered in this DSM study are:

**Powder Coatings** *(for interior and exterior use)*

- 93/7 TGIC
- Uralac® EasyCure
- 95/5 HAA
- 70/30 Hybrid HT 40µ
- 95/5 HAA HT 40µ
- 70/30 Hybrid

**Water-borne industrial alkyd coatings**

- WS Alkyd

**Solvent-borne polyester and acrylic-based high solids coatings**

- Sat PE Conv.
- Acrylic Conv.
- Acrylic high Solids
- Sat PE high Solids

The coating formulations were analyzed on the basis of the amount of energy spent and impact on CO₂ emissions.

The analysis does not include the CO₂ emissions occurring upon destruction of the paint at the end of the service life of the coated object.
### Assumptions:

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Metal Surface</td>
<td>1 m², flat</td>
</tr>
<tr>
<td>Thickness</td>
<td>1 mm</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>
</tr>
<tr>
<td>Pigment / Resin Ratio Pigment</td>
<td>Dependent on product formulation</td>
</tr>
<tr>
<td>Curing Temperature</td>
<td>180°C Powder (Uralac® EasyCure™ at 155°C) 150°C others</td>
</tr>
<tr>
<td>Layer Thickness</td>
<td>40µ - 60µ Powder</td>
</tr>
<tr>
<td></td>
<td>30µ others</td>
</tr>
<tr>
<td>Overspray</td>
<td>0% Powder</td>
</tr>
<tr>
<td></td>
<td>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>
The components of the Life Cycle Analysis of Coatings:

Kg CO₂ eq.

Resin
Solvents
Paint comp. /production
Air heating
Substrate heating
Solvent Incineration

Note: Carbon Footprint expressed as Kg CO₂ eq. per m² coated metal substrate.
The results of the DSM study:

### Solvent Borne
- Sat PE Conv.
- Acrylic Conv.
- Acrylic high Solids
- Sat PE high Solids

### Powder Coating
- 70/30 Hybrid

### Water Borne
- WS Alkyd

### Powder Coating
- 93/7 TGIC
- Uralac® EasyCure
- 95/5 HAA
- 70/30 Hybrid HT 40µ
- 95/5 HAA HT 40µ

**Note:** Carbon Footprint expressed as Kg CO₂ eq. per m² coated metal substrate.
More than one sustainable coating solution:

There are different coating solutions for different applications. For a 1 mm thick industrially coated flat metal substrate we proved that:

- **Water-borne paints and Powder Coatings** produce the lowest Carbon Footprint.

- **Solvent based coatings** typically produce the highest Carbon Footprint.
THE STUDY - CO₂ emissions:

*On a flat metal surface Powder Coatings produce the lowest Carbon Footprint compared to other industrial coating systems.*

Powder coatings at thinner layers generate less than 0,33 kg CO₂ eq per m².

Powder coatings at thicker layers and Water-borne paints generate 0,35 - 0,41 kg CO₂ eq per m².

Solvent-borne and High Solids (@30µ) coatings generate 0,47 - 0,67 kg CO₂ per m².

**Powder Coatings reduce CO2 emissions by 25 – 60% against conventional solvent-borne coating systems.**
If all solvent-borne coatings on metal applications in which currently powder coatings can be applied would be replaced by powder coatings, then the Green House Gas (GHG) emissions avoided would be equivalent to:

*the annual emissions of approximately 9.5 million cars*

or

*to approximately 2.9 million trips around the world in a car,*

or

*the average annual carbon footprint of 1.5 million people in Western Europe*

**Conversion to car kilometers**
To convert savings to car kilometers a well-to-wheel emission factor of 140 g CO₂-eq/km was used as reported in a MIT study (Europe’s Evolving Passenger Vehicle Fleet: Fuel Use and GHG Emissions Scenarios through 2035, Kristian Bodek & John Heywood, March 2008, Publication No. LFEE 2008-03 RP). For round the world trips a conversion factor of 40,000 km/trip was used.

**Conversion to people’s footprint**
To convert to people’s footprint the value for Dutch people for 2006 (10,500 kg CO₂-eq/capita) was used as a representative sample from the United Nations Framework Convention on Climat Change (UNFCCC) data set on the Millennium Development Goals Indicators site of the United Nations (mdgs.un.org)
DSM innovates to make Powder Coatings even more sustainable.

THE STUDY - CO$_2$ 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.
Together with DSM, you can help reduce the Carbon Footprint through sustainable coating solutions.

By using sustainable coatings throughout the value chain, together we can all help reduce the Carbon Footprint.

By delivering the right raw materials, DSM supports development and growth of sustainable coating solutions.

DSM is the only Global, Committed and Innovative Powder Coating Resins supplier.
Want to know more about this study?

If you would like to know more about this study, or how much impact the coating formulation you use has on the Carbon Footprint, contact:

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Enabling you to make the right choices.

You can now assess your coating formulations in a way that is comparable across the industry.