Carbon Footprint Study for Industrial Coatings Applied on a Metal Substrate

Focus on Powder Coatings
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.

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.
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.
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.
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.
**DSM’s Mission and Sustainability**

Our purpose is to create brighter lives for people today, and for generations to come. This mission is supported by our core value, which is that our activities should contribute to a more sustainable world.

By ‘sustainable’ we mean ‘meeting the needs of the present without compromising the ability of future generations to meet their own needs’. This is the widely accepted definition that the Brundtland Commission published in 1987. Like the Commission, we believe that achieving sustainability means simultaneously pursuing economic performance, environmental quality and social responsibility, in other words, creating value on the three dimensions of People, Planet and Profit simultaneously. This is the ‘Triple P’ philosophy.
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 conducts LCA* studies to maintain its high-level of commitment to Sustainability.

DSM LCA* methodology:
- SimaPro and Ecoinvent 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 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.
LCA Study for Industrial Coatings

This analysis aims to compare the carbon footprint of powder coatings with that of common liquid coatings.

The study includes impacts from cradle up to the application of the coatings onto a 1m², 1mm thick steel substrate.

All raw materials used in the production of the resin binders and final coating formulations have been taken into account.

The application phase analysis includes, where relevant, the energy required to heat the substrate, evaporate the solvents, and pre-heat the air entering the curing oven to maintain the atmosphere below explosive limits.

Incineration of solvents is assumed with the associated release of CO₂ from the combustion of organic materials. This assessment is intended for B2B purposes and as such does not include the full life cycle of the studied products.
The coating formulations covered in this DSM study are:

**Powder Coatings** (for interior and exterior use)
- 93/7 TGO
- UltraCure EasyCure
- 95/5 HAA
- 95/5 Hybrid H7 eco
- 93/5 HAA HT 001
- 93/5 Hybrid

**Water-borne industrial alkyd coatings**
- WS Alkyd

**Solvent-borne polyester and acrylic-based high solids coatings**
- Sat PE Comc.
- Acrylic Comc.
- 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.

This analysis does not include the CO₂ emissions occurring upon destruction of the paint at the end of the service life of the coated object.

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**LCA Analysis of 11 Industrial Coatings**

The study covers the analysis of 11 coating formulations applied to 1m² 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 and Methodology of the Study

Next to all of the above stated assumptions, the following methodology was applied: the carbon footprint was calculated using the IPCC 2007 GWP 100a assessment method and the results are expressed as kg CO2 equivalents, using the associated characterization factors for the relevant greenhouse gases.

An assessment was made of each coating system using the Eco-indicator 99 method to check for unexpected environmental impacts in categories relating to human health, ecosystem quality and resource depletion.

The LCA software SimaPro 7.2.4 has been used for this study. This software contains the Eco-Invent v2.2 database which details the environmental profile of a large number of chemical processes and substances. We have used the data available from this database where possible, and defined our own where necessary.
Components of this LCA Analysis

1. The substrate is 1m² of 1mm thick steel.¹
2. The impacts of the energy required to evaporate solvents and water
3. The impacts of the energy required for substrate heating
4. The impacts of the energy required to heat the process air *
5. The CO₂ emissions from solvent incineration**
6. To calculate the quantity of each coating required*** the following parameters were taken into account:
   a) Solids content
   b) Pigment / binder ratio
   c) Application thickness of cured, dried coating
   d) Transfer efficiency

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

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.

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

In our efforts to reduce the eco footprint of our powder coating systems, we strive to take the industry one step further. Our intention is to invest in new systems for new application areas and substrates that go beyond the traditional metal substrates, such as wood and plastic. Working in close partnership with our customers, our mission is to help Shaping the Powder Coating Industry as a whole, by creating sustainable solutions for the future.
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.dsmcoatingresins.com and select Sustainability page.