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POWDER COATINGS FOR WALLBOARD

Powder coating could enhance the sustainability of gypsum wallboard and ceiling tiles through new functionalities and flexibility.

Powder coating was developed in the late 1950s to coat metals without solvents. A powder is negatively charged and is attracted to the metal, which is positively charged. Once the powder is applied, it goes through an oven to flow and cure the powder. Its polymers cross-link to provide its durable characteristics.

Today, powder coating can be carried out on a range of substrates, including building materials like gypsum wallboard. It allows users to apply different colours and textures, and functionalities like high abrasion resistance and high moisture resistance. Alternatively, powder coatings can also be air- and moisture-permeable, enabling wood-based materials to breathe as they would without a finish. Primer coats can also be applied to ensure good adhesion with liquid paints. It's a very versatile technology.

Climate Surfaces began powder coating building materials in 2001. Since 2006, it has used this process to convert gypsum wallboards into bespoke ceiling tiles and wall panels. From its native New Zealand, Climate Surfaces now also offers low-cure powder coating equipment and know-how, so that its clients can produce their own coated products. Its coating process and powder coatings are among the best in class, using relatively low temperatures of 130-140°C and a residence time of just five minutes.

The benefits of powder coating

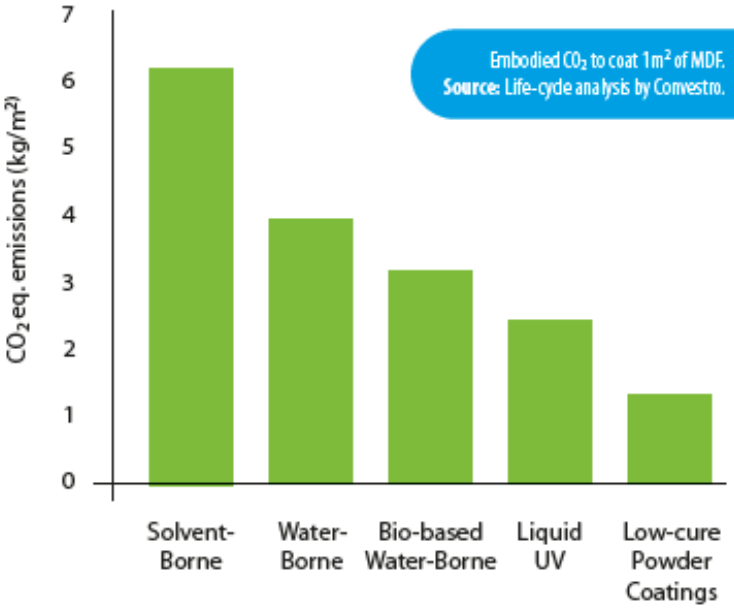
Powder coating is a very sustainable way to coat building materials compared to PVC foils and water-based UV curable methods. A single coat can be 90-150µm thick, about the same as 3-5 coats of a liquid-based coating. A life-cycle analysis study by powder resin manufacturer Covestro demonstrated that the CO_2 footprint of low-cure powder coatings is around 75% lower than solvent-based coatings, 48% lower than

Powder coated gypsum wallboard used as a wall panel.

water-based coatings and 38% lower than liquid UV technologies.

Additionally, the lack of solvent means that solvent is not lost to the atmosphere, which is better for workers and the environment. It also saves costs, with up to 95% powder utilisation possible with powder coatings. In 2022, Climate Surfaces installed its own powder manufacturing plant. This has enabled it to increase its powder utilisation rate to 99%. Any non-adhered powder is reused as a filler in new powder material.

Another major advantage of powder coating is that it allows gypsum wallboard to move into non-traditional applications. For example, many ceiling tiles are energy-intensive to produce and difficult to recycle, due to them containing vinyl laminates. In comparison, powder-coated wallboards can be used for this application and remain recyclable, as confirmed by a range of third-party tests. This realisation invites us to think differently about how powder-coated wallboards – and other powder-coated building materials – can be used in different, more sustainable ways in the future.



Embodied CO_2 to coat 1m² of MDF.
Source: Life-cycle analysis by Convestro.

The future of powder coatings

There are several emerging approaches that could further enhance the environmental credentials of powder coatings themselves. These include using recycled 'waste' plastics, including polyethylene terephthalate (PET) bottles, as the basis for powders. Biogenic powders, which have the possibility of becoming CO_2-negative, are also under investigation. In any case, further developments in conventional powders could see curing temperatures fall to below 100°C.

Producers can also manufacture products so that they are as easy as possible to recycle. For example, labelling the backs of coated ceiling tiles with a QR code would enable deconstruction / demolition firms to identify the manufacturer and contents of panels decades after they are installed. The tiles can then be either recycled or returned to the manufacturer for refurbishment, in line with best practice.

So far, Climate Surfaces' observation is that these kinds of circular approaches will become increasingly important in the light building materials sector of the future. There is likely to be a considerable shift towards reuseable panels that can be removed without damage. This necessitates a shift away from nailing, glueing and screwing boards into timber and steel framing joists and to rethink how panels, indeed how the built environment, is built and used.

Powder coated gypsum wallboard used as a ceiling tile.

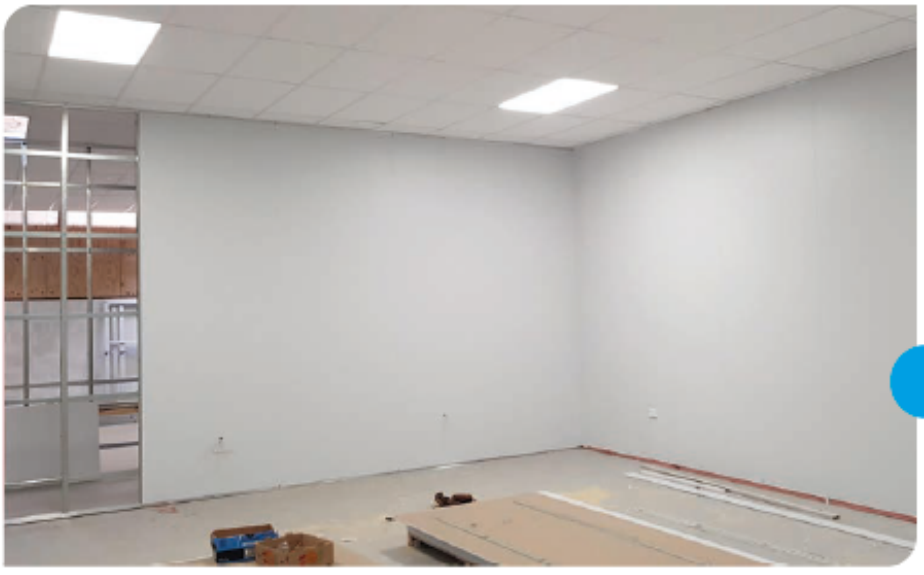
X-Frame, a fellow New Zealand-based outfit, has developed a clever system that relies on a computer numerical control system and plywood sheets. Framing components are cut out and can be assembled like flat pack furniture. Panels, in this case made of MDF, are then attached. It would be just as easy to use a powder-coated gypsum wallboard for a fire-proof, aesthetically-pleasing and robust finish. Wonderwall, active in Belgium and the Netherlands, is another company building panelled wall systems that can be deconstructed and reconfigured. Juunoo has also developed an innovative steel framing system that has no screws or permanent fixings. It can be built and taken apart repeatedly, ensuring a high level of flexibility.

Other companies, including Climate Surfaces, have developed prototype hook-based systems, as well as Velcro- and magnet-based fixing systems. They work too... Just because we are used to permanently fixing panels in place with screws and adhesive, it doesn't mean it will always be this way.

Savings through sustainability

Each of these reconfigurable systems are – or will be – more expensive than current approaches, at least at first. However, the price starts to come down when we look at how long the system can be used. To reconfigure an office block, hospital ward or classroom with wallboard needs new wallboard. After one or two redesigns, the price of new materials – not to mention labour – will soon exceed the cost of the reuseable system. As finished panels, powder-coated wallboard would not need to be reskimmed or repainted, saving considerable time and money.

These are some of the reasons that modular, reconfigurable light building materials - often featuring powder coatings - are already on the radar of architects, developers and designers. Often working in the retail and office market, where there is a 3-7 year refurbishment cycle, they are looking for solutions that provide flexibility for wall partitions. This flexibility means that it should be possible to sell advanced framing and panel systems at 3-5 times the price of conventional wallboard-based systems. This will be worth paying in the circular economy of the near future – and circularity is here to stay.



Prototype system by Climate Surfaces.