Reducing Reworking and Powder Consumption

The systematic measurement of powder coatings to keep their thickness to a minimum is a simple way of achieving major environmental benefits. Hand-held ultrasonic devices are the ideal solution for making non-contact coating measurements of this kind.

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For around 20 years it has been possible to carry out non-contact measurements of uncured powder coatings using hand-held ultrasonic gauges to determine the coating thickness before the coating is cured in the oven. The result is that reworking and unnecessary powder consumption in many cases could become things of the past. Annual savings of 100,000 to 200,000 tonnes of powder could be achieved worldwide. This corresponds to emissions of 380,000 to 760,000 tonnes of CO_2, which is the equivalent of a car travelling 2.2 to 4.4 billion kilometres (Euro 6)*. Despite the huge potential savings, many small and medium-sized powder coating companies are not yet using these measuring devices.

Supplying hand-held air-ultrasonic measuring equipment for 20 years

Hand-held ultrasonic measuring devices have been available on the market for some time. Systems using non-contact air-ultrasonic methods to measure uncured powder coatings were first introduced in 1997. In the summer of 1999, the first range of Powdersave hand-held devices was supplied by Initiator and the then licence holder Hans-Ulrich Ramseier and Ramseier AG. A few of these devices are still in use today.

After a period of more than ten years when the Powdersave and the identical Elcometer 550 with an OEM badge were the only air-ultrasonic powder coating thickness gauges available, in 2010 the licence owner Innotest AG launched the successor to Powdersave, the SaveCoat 7 or Elcometer 550, at almost exactly the same time as the PosiTector PC Powder Checker was introduced by DeFelsko Corporation in the USA. The US device uses the same measurement method. It has a lower purchase price and a measurement range that is restricted to approximately 75 µm (see IST 2/2012).

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Figure 1 > Hand-held ultrasonic devices can produce reliable measurements even on curved surfaces, such as this cycle frame.

Comparison with alternative measuring processes

The main alternatives to ultrasonic powder measuring systems are thermographic and photothermic devices. Because they have to be adjusted to the shade of colour, the substrate and the type of powder, photothermic units are more time-consuming and complex to set up and use for measuring powder coatings and are also more expensive to purchase than air-ultrasonic systems. In addition, the measurement process is slightly slower and the maximum measurement rate correspondingly lower. This is a particular disadvantage when measuring moving products on a production line.

Figure 2 > Example of powder coated facade panels on the town hall in Volketswil in Switzerland.

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Simple, universal ultrasonic measurement systems

The hand-held ultrasonic devices that are currently available are easy and reliable to use. After a simple zeroing process (recording the reference signal), the devices can take measurements on all kinds of substrates (metals, MDF, wood, glass and plastic) regardless of the colour or type of powder. The measurement accuracy corresponds with the manufacturers' specifications for all types of application processes (Tribo or Corona application) (see IST 10/2014).

Easy measurements even on curved surfaces

Using a sound beam that is narrow at the measurement distance, ultrasonic gauges can measure small areas and components with highly curved surfaces. This is demonstrated by the fact that a laser guiding function was introduced in the SaveCoat 7 hand-held device for the first time in 2011 and that this measurement gauge has been successfully used since then by a number of cycle manufacturers *(Figure 1)*.

Few disadvantages to ultrasonic powder coating thickness measurement

It takes a little time to become familiar with the measurement process using a hand-held ultrasonic device, which involves collecting the ultrasonic measurement signals. It would also be very useful if the upper limit of the measurement range for the final coating thickness, currently approximately 75 µm for the Powder Checker and 100 µm for the SaveCoat 7 (see IST 2/2012), could be increased.

Saving powder and avoiding reworking and faults

Since the market launch of these gauges, several articles have been written about the powder savings that are possible with the systematic use of the systems, which can amount to 10 percent or more, and the reduction in the number of cases of faults. For example, Line operators could achieve daily savings of 400 Swiss francs (around 350 euros) by improving the set-up of their production lines (see IST 2/2011).

Measuring powder coating thickness on facade panels

In the 1990s, paints were generally used to coat facade panels, but since then powder coatings have become more and more popular. Applying powder coatings to large panels can be a particularly tricky task. Users' requirements for special colour effects have made the process even more difficult. The overall finish of the facade must be consistent and unblemished. In some cases the patchwork effect is only noticeable when the panels have been fitted and this leads to highly costly reworking and replacement of the components.
Successful examples of the use of specially powder-coated facade elements include the new One World Trade Centre Tower, the science building at Columbia University in New York and the new town hall in Volketswil in Switzerland *(Figure 2)*. A gold anodised coating was used for the building in Volketswil and this was applied by Jürg Hofstetter AG. The systematic measurement of the uncured powder helped to ensure that the coating had a consistent thickness and met the required quality standards.

Greater potential for reducing environmental impacts and saving money

Powder coating companies with an annual consumption of more than 5 tonnes of powder can achieve significant savings using an ultrasonic measuring device. The systems can also be used systematically by plant operators as part of their quality control processes to keep costs low. The important factors include not only identifying the thickness of the coating, but also improving the quality of the finish and reducing resource use.
Reffnet, the Swiss resource efficiency network, has been commissioned by the Swiss Federal Office for the Environment

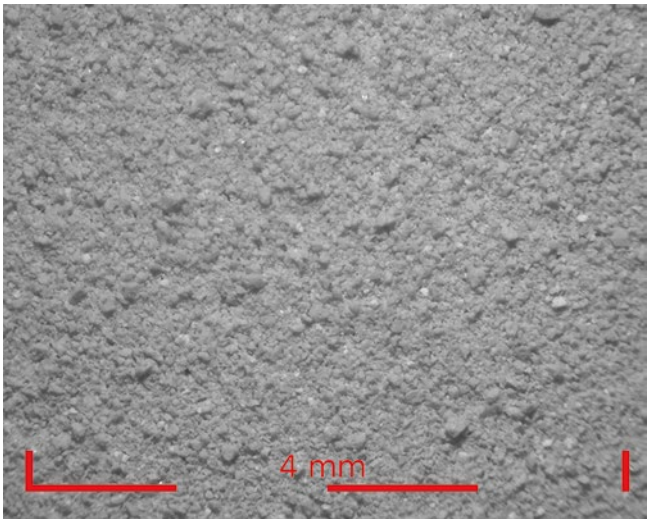

Figure 3 > Image of an uncured powder coating taken under a microscope. If the coating covers the surface, the visual appearance of the coating will be the same across a wide range of different thicknesses.

(FOEN) to help manufacturing companies to introduce more environmentally friendly solutions. The aim of the government funded program is to enable better results to be achieved in future at a lower cost and, at the same time, to reduce the impact of production processes on the environment. Industrial processes that focus on the material used and that allow savings to be scaled up have been shown to be highly promising in this respect. One of these is powder coating.

The systematic measurement of powder coatings in order to keep their thickness to the minimum required can make a major contribution to reducing the environmental impact of the process that is also easy to achieve. The following quantitative information about the economic and environmental efficiency of powder coating thickness measurements was obtained by experts from Reffnet who surveyed a number of users in Switzerland with the aim of identifying realistic assumptions that could be used to carry out more detailed calculations of the benefits. These assumptions were as follows:

- Powder coating plant, approximately 60 load bars/hangers per day
- Average powder consumption of 3.5 kg per load bar/hanger
- Powder purchase price: 11 Swiss francs (around 9.65 euros) per kg
- Powder wastage: 50%

In real production environments, attempts are made to recover wasted powder. For this reason, load bars with parts to be coated in the same colour are grouped together. It is cost-effective to recover powder where there are two or more load bars in the same colour. The weekly powder consumption in a production environment with small orders on one load bar and larger orders on several load bars including powder recovery is assumed to be 775 kg, with 525 kg being applied to the products and 250 kg being wasted (see *Table 1*).

The benefits of systematic measurement of powder coatings

Powder savings

Some powder coating companies systematically measure their coating thicknesses before the curing process. Surveys carried out in the industry show that this leads on average to reductions of at least 10% in powder consumption. This allows for weekly savings of 5.25 kg of powder or 600 Swiss francs (around 520 euros), which corresponds to a saving of 30,000 Swiss francs (26,300 euros) per year. Each measuring device with a purchase price of less than 10,000 Swiss francs (8,800 euros) can reduce powder use by around 26 tonnes over ten years. This is the equivalent of a fully loaded truck.

However, additional costs will be incurred during the production process. The additional measurement tasks are expected to take around 0.5 hours per day. At an hourly rate of 100 Swiss francs (87 euros), this amounts to an additional expense of 12,500 Swiss francs (11,000 euros) per year. The net benefit from the powder savings and the additional cost of measurements therefore is 17,500 Swiss francs per year (15,300 euros).

Preventing faults

The systematic measurement of coatings before curing also allows faults to be prevented. Take the following scenario for example: an order for around 1500 square metres of facade panels (this corresponds to around one day's production) has to be reworked because of problems with the quality. The panels are coated for a second time. The cost of the first coating per square metre is around 15 to 20 Swiss francs (13 to 18 euros). For the second coating the cost will be slightly higher. The total cost of the reworking is between 25,000 and 35,000 Swiss francs (22,000 and 31,000 euros). Another benefit of using the measuring device is the fact that faulty areas can be reworked relatively simply.

If unusual situations, such as faults caused by inaccurate coating thicknesses, are also taken into consideration, for the coating company described above the use of the measurement gauge brings an added benefit of 30,000 Swiss francs (26,500 euros) per year on average because of the faults that have been prevented. The occurrence of unusual faults that require reworking in one order per year is a conservative estimate. In reality the figure and the additional work involved as a re-

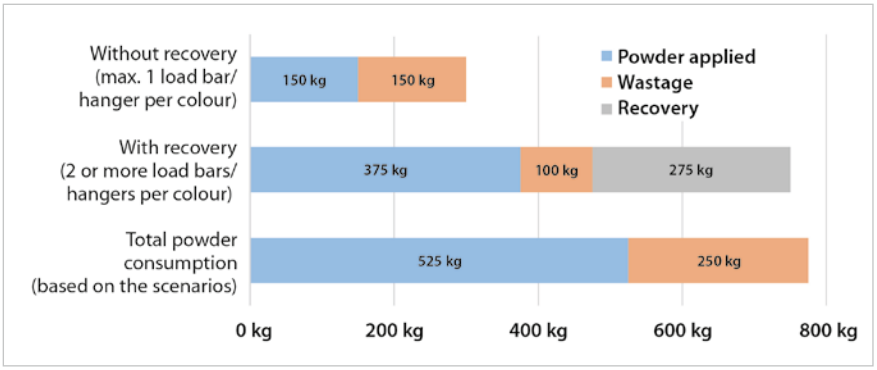

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Figure 4 > Weekly powder consumption.

sult of not measuring coating thicknesses systematically can be much greater.
The measuring devices help to reduce powder consumption and to prevent costly faults. The resulting annual savings can be as much as 50,000 Swiss francs (44,000 euros).

A significant benefit for the environment
From an environmental perspective, this type of quality assurance system is highly valuable. If powder savings of 10% can be achieved in a typical powder coating plant by systematically measuring the coating thickness and if one small fault per year can be prevented, the environmental payback period is one month on the basis of a CO_2 calculation. In other words, the device and the additional measurement work will have paid for themselves after a month. The estimate of an average powder saving of 10% is conservative. In addition, the CO_2 calculation for a (typical) fault is based only on recoating the surface in a modern, efficient powder coating plant. If the parts have to be stripped or even replaced, the environmental payback period will be even shorter and the environmental benefit much greater than that described above.

Conclusion: cutting costs and protecting the environment

The use of non-contact air-ultrasonic hand-held measuring devices in the powder coating process avoids the need for reworking and can help to reduce powder consumption by 10% or more. Realistic assumptions show that the measurement systems can bring significant financial benefits for small and medium-sized powder users. The increase in profits can be accompanied by a considerable reduction in the environmental impact of the process. In this case the financial considerations and the environmental benefits are not in conflict with one another. As a result, the use of ultrasonic coating thickness measurement devices is much more attractive than might be suspected and supports the efforts being made throughout society as a whole to achieve more using fewer resources and, at the same time, to reduce environmental impacts. //

*Assumptions: 173 g CO_2 per km (according to Mobitool) travelled by a car (diesel car, average for the fleet in Switzerland, Euro 6).

	Without recovery (maximum of 1 load bar/ hanger per colour)	With recovery (2 or more load bars/ hangers per colour)
Gross consumption	300 kg	750 kg
Powder wastage	150 kg	375 kg
2 load bars/hangers or more with recovery	0	-275 kg
Powder consumption per week	300 kg	475 kg
Powder consumption per week	775 kg	

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Table 1 > Weekly powder consumption with and without recovery – 775 kg powder used, 525 kg on the product, 250 kg wasted.

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