

Precoating gives Integrated Dishwashers an Elegant Metallic Look

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Coil coating satisfies the demands of both economy and functionality

The term “white goods” has become a synonym for domestic appliances of all kinds, even though, both in households and commercial applications, these appliances today come in elegant stainless steel or metallic colours and with surfaces made of wood or bright-coloured plastic. To ensure that all the smooth and textured surfaces of the appliances withstand the attacks of daily rough treatment over several years, these surfaces must be extremely robust. Even the protective and decorative exterior coatings of integrated appliances are exposed to extreme chemical and physical stresses, despite the fact that these exterior surfaces are invisible once the appliances are installed and operational. New coil coating systems now provide attractive prospects for modern production processes and designs. A potential which was fully brought out in cooperation between Miele, BASF and the Salzgitter Group as steel supplier.

At a time when the global appliance industry is facing declining sales and rock-bottom price-slashing strategies, the German manufacturer Miele has surprised everyone by taking a totally opposite tack. Despite – or perhaps precisely because of – its unorthodox



Painting process in coil coating for domestic appliances in Salzgitter

approach, this traditional company is enjoying exceptional success with its premium-quality strategy, not only in Europe but also in the USA and even in China. This global success has been achieved despite the fact that the vast majority of Miele appliances are manufactured in Germany.

Productivity as a factor of success

Over the last five years, Miele has invested 645 million euros in research, development, production and marketing. Moreover, the company's route to success has been characterised by added value and value-added partnerships. The importance of these partnerships was made evident in a round-table discussion between eight experts

from Miele, BASF Coatings and the Salzgitter Group at the Miele plant in Bielefeld (*see list of attendees at end of article*).

Through their intensive collaboration, these experts have made decisive contributions to significant recent progress. Their project-based reflections clearly illustrate how successful companies have shifted almost imperceptibly from classic “buyer-seller” relationships towards more innovation-friendly value-added partnerships. However, as Wilfried Rott, Purchasing Manager at Miele confirms, this transformation cannot take place without comprehensive rationalisation measures. “New ideas from our suppliers and operative freedom of manoeuvre for Purchasing are as important here as systematic in-house stimulation of



Latest generation integrated dishwasher.

innovation, all the way from product planning through production to marketing and sales promotion.”

In addition to promoting innovation, the aims of value-added partnerships are to enhance performance and productivity, improve quality management and market acceptance, increase income, safeguard the future etc. At the same time, development alliances and know-how networks respond faster and more accurately than classic systems to the individual requirements of international markets, as this preliminary summary of the round table discussion shows. Moreover, value-added partnerships also bring competitive advantages. After all, it is not easy to imitate a network of partners that have the top skills and competence in their specific fields. Also, this form of alliance is redefining the concept of

“technological leadership”, through concentrated “input and output”.

But first things first: Miele products are brand-name articles in the premium segment. In countless tests and international opinion polls, they repeatedly confirm their durability, ease of use and functionality combined with a modern elegance that constantly adapts to the spirit of the times. “Our corporate and product image is something that our competitors envy and aspire to,” says Jürgen Bergmann, Factory Manager of Miele's Bielefeld Production Plant, “but maintaining this image demands immense efforts.” One example is the new generation of Miele dishwashers, which in addition to many technical innovations and novelties for home appliances also uses precoated metallic-look casing components.

How it all began ...

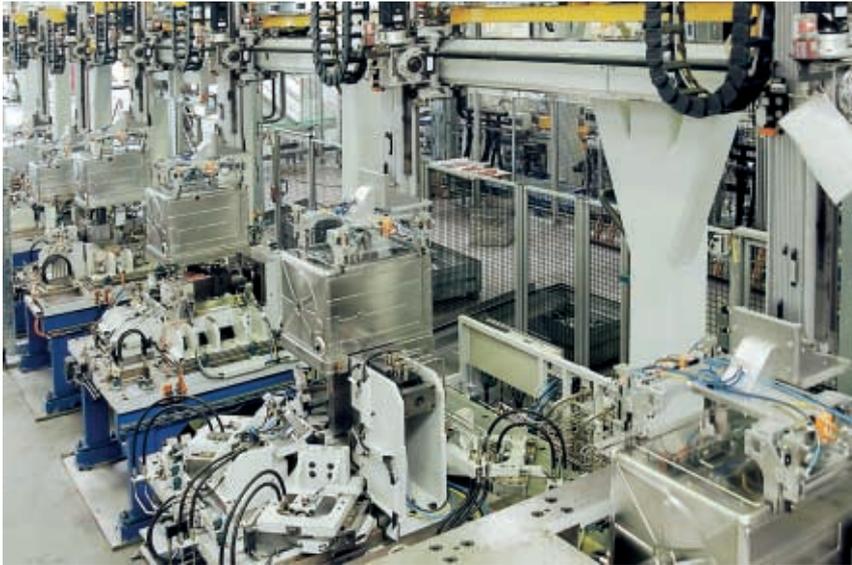
Since starting industrial mass production in 1960, about 10 million dishwashers have been manufactured at Miele. Just under three and a half years ago, the company gave the go-ahead for the development of the latest generation of appliances, based on an entirely new design. The result is a reduction in the number of parts, increased functionality, a variety of technological advances and a highly aesthetic appearance – even in the case of integrated appliances for presentation in retail showrooms (i.e. without end-user fascias) – an innovation that was enthusiastically welcomed by the markets.

The production process is a fully integrated one, and all stages are monitored, logged and compared with specified values. In the event of any deviations, corrective action can be taken directly in the production processes.

The modified construction of the dishwashers has enabled Miele to bring models with entirely new appearance and features to the market. These appliances are highly attractive even at first sight. The components are coated using a new technology, so that now even in the case of integrated and fully integrated appliances without finish screens, the side and front panels have a silver-metallic gloss, giving these parts the elegant looks of a stainless steel or aluminium surface at low cost. At the same time, considerable improvements in scratch resistance have been made possible.

Not new – but with new fields of application

Coil coating is meeting increased interest worldwide. It can be described in a nutshell by the motto: “Finish first, fabricate later”. In technologically demanding but still



A new washing chamber (tub) is the basis for the innovative appliance generation. It is produced by 5-sided internal high-pressure forming. Using this method, the entire inner tub of the dishwasher can be formed in a single process, instead of the previous method of welding the side, base and top panels to the back panel. In addition to simplifying production, this method has the advantages of improved robustness (including savings on additional frames and load-bearing components) and better shaping of the interior chamber.

economical high-speed processes, pretreated thin steel coils are continuously coated with primer and topcoats directly at the steel production plant, before being rewound in large coils. They are then delivered in coils or sheets to the next stage of processing to be cut, formed and joined according to their application, for example in the building, appliance and automotive industries.

These industries can then manufacture the relevant parts without having to worry about a downstream coating process, since coating has been shifted to an earlier stage of production. The use of the organically coated materials with their decorative, anti-corrosion and other functionality-enhancing chemical and physical properties is based on the fact that batch coating and all its related problems have only marginal impact on the final processing stage. Investment in the manufacturer's "own" coating plant is no longer necessary, and the related fixed and operating costs, including expenditure on environmental protection, pre-treatment, wastewater treatment, exhaust air treatment and waste

disposal are eliminated. The costs of the coating process and of environmental protection are therefore much lower when coil coating is involved, and pollution is also reduced. Anne Heimes-Scheller, head of Precoatings Product Management at BASF Coatings AG, is therefore convinced that "we, together with our immediate customers and the downstream links in our supply chain, can find many other applications and marketing possibilities for coil coatings besides the construction and home appliance industries".

Maximum efficiency

At present, about 60 plants in Europe coat 0.2 to 2 mm thick cold-rolled coils of mild steels or general construction steels, electro-galvanised thin sheet, hot-dip galvanised steel coil or aluminium with its malleable wrought alloys. The maximum coil widths are about 1800 mm for steel coils and about 2000 mm for aluminium coils. During coating, throughput speeds of up to 200 m/min (steel) and 80 to 140 m/min (aluminium) are attained. Most plants are set up for two

application stages, i.e. firstly a primer and secondly a topcoat on the front side and a protective coating on the back, or else topcoats on both sides of the coil. The equipment is completed by a baking oven, cooling zone and lamination station. As with every industrial coating of metal substrates, a perfect coil surface is necessary for high quality coil coating. To this end, chemical and mechanical cleaning operations are performed. The substrates are then pre-treated by dip-coating, spray coating or roller application processes. Modern requirements have led to the replacement of formulas containing chrome by chrome-free materials, both for the pre-treatment products and the primer. At present, the roller application process is used for 98% of primer and topcoat applications. This permits high productivity, combined with high transfer efficiency, so that the coil coating process can be considered to be the most efficient coating method in terms of coated surface area per unit time. In addition, the short period between application and crosslinking permits an extremely efficient reduction of solvent emissions – through thermal oxidation of the emission sources from the application zone and the driers without additional energy input. However, high demands are made on the coating materials during the complex processing stages, and these demands are not confined simply to their rheological characteristics. Consequently, in order to obtain high-quality surfaces, particular experience of reproducible formulas and their components and additives is required. Adequate knowledge of processes and application methods is equally important, because the same material used on three different machines will lead to three different end results. BASF Coatings AG in Münster, with its high performance and service potential, has specialised in this field and is therefore one of the international market leaders.



Foodstuffs resistance test at
BASF Coatings AG

Historical background

In Germany, coil coating was first used in the 1970s for integrated refrigerators in hotels, i.e. minibars. In the early 1980s, in much larger scale, the process was used for refrigerator casings. The technology was definitively established in 1993 with the production of tumble driers from precoated material. Through successful value-added partnerships between home appliance manufacturers, coil coaters and paint manufacturers, the product portfolio for white goods was repeatedly expanded, so that today a wide range of domestic appliances can be manufactured using precoated materials. The standard fields of application now include dishwashers, washing machines, tumble driers, cookers, microwave ovens, extractor hoods, refrigerators and freezers etc. This progress is further favoured by the prevailing consumer trend of the 21st century (preference for rounded corners and flowing forms, with comfort and functionalism combined with a sense of “well-being”).

Although “white” is still the dominant colour in these market segments, bright-coloured home appliances or stylish metal looks are

increasingly characterising consumer demand. The stainless steel look, plagued by the “fingerprint problem”, has always been a challenge for steel coaters and paint manufacturers alike.

The technological challenges for the paints used in coil coating are considered to have been largely solved. However, as the Miele example shows, only individual initiatives combined with close intercommunication within valued-added partnerships between paint manufacturers, coil coaters, coil users and end users can produce optimal results and maximum return on investment. “Coil coating is by no means a simple enterprise – but the results justify the efforts involved in every respect,” considers the round table.

Progress initiative

Several years ago, Miele was already asking its supplier, Hövelmann & Lueg GmbH, a company of the Salzgitter Group in Schwerte, to supply cut lengths of white coil-coated steel conforming to individual specifications. Jürgen Bergmann remembers: “As a replacement for the powder coating method applied at Miele, the cut sheets had to be coated with a ready-for-use final coating, in order to provide better friction properties for the forming process.” This first solution proved highly successful.

Hövelmann & Lueg is a “Steel Service Centre” and therefore a competent partner of both steel producers and steel users. Its range of services includes standard, special and system solutions (based on an integrated service network within the Salzgitter Group = steel production, steel processing and retail), together with cross-cutting, longitudinal cutting, precision cutting, storage and logistics, material testing and more. This partner had proved itself to be

extremely capable during the “white solution” process, and so Jürgen Bergmann and Wilfried Rott again urged Hövelmann & Lueg, via Thomas Köppe, to provide top performance.

The trigger was another Miele idea: “The integrated and fully integrated appliances of the latest dishwasher generation must be given an attractive appearance by means of coil coating, so that they are seen as desirable as soon as a customer first sets eyes on them in the showroom!” The side panels and front fascia were expected to glitter in silver metallic, in order to imitate stainless steel or other attractive metal looks – without generating their costs.

Thomas Köppe and Hövelmann & Lueg, at the same time as they were engaged in the installation of a new multi-blanking line for the manufacture of special panels and cut shapes for maximum surface quality requirements, accepted the challenge and passed the problem on to Salzgitter Flachstahl GmbH, in Salzgitter. Jana Heß for Technical Customer Service and Matthias Hartmann as Sales Manager remained in contact with the customer, whilst Uwe Kruse with his production plants and specialised personnel was requested to deliver the desired results. Salzgitter Flachstahl had also just invested in the latest technology, and so here too the idea was tackled ad hoc. However, Uwe Kruse knew that “Coil coating, coil coating plant in general and new systems have individual characteristics – and so the task will not be simple”.

Through intensive contact between Miele and Technical Customer Service at SZFG a product proposal was worked out together with BASF Coatings. After technical lab evaluation by Dr. Thorsten Reier, Manager Surface Technology at Salzgitter Mannesmann Forschung GmbH, samples were presented to Miele. Jana Heß clearly remembers

the day when Jürgen Bergmann congratulated her on the solution but summarised the result of the Miele tests and internal inspection opinions: slightly more metallic gloss was desired, and this would have to be produced and submitted for further testing as soon as possible.

New ground

Now, coil coatings already in themselves represent a major technological achievement. In many applications, in particular the production of home appliances, the precoated panels are exposed to extreme deformations during processing and assembly. The metal is bent, crimped, pressed and deep drawn, without any delamination or crack being permitted in the coating. The surface has to remain perfectly defect-free, in order to be able to meet the strictest demands. The end user then evaluates both the appearance of the appliances and their functional performance immediately before sale in the store and naturally expects there to be no problems in the rough and tumble of everyday use. The general characteristics required of coil coated panels in the home appliance sector therefore include high flexibility, hardness, anti-corrosion properties and resistance to light and to a wide variety of mechanical as well as chemical and physical factors. Heat and cold and resistance to foodstuffs and aggressive substances in detergents, ketchup, mustard, vinegar, spices, shoe polishes etc. are naturally also integral to the requirements profile.

These specifications can be met by either a polyurethane or a polyester system. In this case, the final use is of key importance. The typical substrates are hot-dip galvanised steel, electro-galvanised steel, cold-rolled steel and aluminium.

“Now, achieving an appearance that is constantly and reproducibly



Performance of a caustic soda detergent test at BASF Coatings AG.

obtained first in the lab and then on coil coating lines, so that it meets the trend standard, is a real challenge,” explains Dr. Reier. Consequently, the possibilities of obtaining the metallic surface in the desired manner was discussed with Customer Service at Salzgitter and with BASF Coatings. At first, BASF Coatings said that “even more glossy is quite impossible, but we will work on it”. However, the samples presented only a short time later to Miele by Jana Heß led to the first trial application, initially for exhibition models. On producing these appliances, Miele then observed that increased scratch resistance of the coating would be desirable. The conventional coating system consisting of a standard primer and a metallic topcoat was therefore discounted for Miele. The substitute that was now feverishly sought was found in the unusual combination of a metallic-grey coloured polyurethane basecoat with a polyester clearcoat, which through its special modification improves brilliance and ensures all the desired properties. This combination proved to be fully compatible with the coating line and also ensured stability of the systems during application. The ultra-modern production line recently started up at Salzgitter Flachstahl monitors the

process and the coating result fully electronically and – in the event of any deviations – already reacts after the coil has advanced only 30 cm. After a final colour correction requested by the customer, the new variant received top marks in the Miele tests and was given the go-ahead for full-scale production.

Possibilities

BASF Coatings AG delivers a variety of individual coating materials for home appliances of established makes. Each manufacturer applies its own specific standards, test criteria and audits. The Miele application provided a unique challenge that required new approaches to be sought and found before the solution was eventually achieved.

This new concept now benefits not only Salzgitter Flachstahl GmbH and Miele but also the cut product suppliers Hövelmann & Lueg. This company is responsible for incoming inspections, storage, cutting to length, special treatments, overall logistics and delivery on demand.

Jürgen Bergmann can therefore be more than happy with the result of his value-added partnerships: “The

innovation process was extremely satisfying for Miele," he concluded in summary. "The real time line between the initial request and the final solution was only four to five months – an exemplary demonstration of competence. The stainless steel look was fully achieved. Even next to titanium and aluminium, Miele's Zermatt silver holds its own." He believes that a technology transfer to free-standing appliances is probably only a question of time. For Wilfried Rott, on the basis of this success, other applications in different fields of the company's production programme have become the focus of particular attention. Who knows, perhaps the same value-added partners will soon be sitting together at a desk to discuss possible solutions for another fashionable colour, such as anthracite!

Participants in the Miele "Coil Coating" round table

Jürgen Bergmann, Dipl.-Ing.
Miele & Cie. GmbH & Co., Factory
Manager of Miele's Bielefeld Production
Plant. 25 years at Miele, Factory
Manager for 11 years. Previously
responsible for automation in Bielefeld.

Wilfried Rott,
Miele & Cie. GmbH & Co., Purchasing
Manager. 30 years at Miele, 15 years
deputy Purchasing Manager in
Gütersloh. Purchasing Manager at
Bielefeld for 1 year.

Jana Heß, Dipl.-Ing.
Salzgitter Flachstahl GmbH, Salzgitter.
Technical Customer Service, responsible
for the Miele account.

Uwe Kruse, Dipl.-Ing.
Salzgitter Flachstahl GmbH, Salzgitter.
16 years with the company, Production
Manager Coil-Coating for 3 years.

Matthias Hartmann,
Salzgitter Flachstahl GmbH, Salzgitter.
Sales Manager, Home Appliances. Has
been working in the Flachstahl sales
department since 1999.

Dr. Thorsten Reier,
Salzgitter Mannesmann Forschung
GmbH, Salzgitter. Joined the
Research/Application Technology
division of Salzgitter AG in 1998.
Manager Surface Technology since mid-
2003.

Thomas Köppe,
Hövelmann & Lueg GmbH, Schwerte.
Industry Sales Manager at the Steel
Service Centre since 1992.

Anne Heimes-Scheller,
BASF Coatings AG, Münster.
Precoatings Product Management and
Marketing in Industrial Coatings
Solutions.