New Ideas for Anodising Aluminium

A thorough examination of the "standard" processes for anodising aluminium highlights new ways of reducing costs while maintaining the same high level of quality. The focus is on cutting the time needed for the anodising and sealing phases.

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Aluminium is used in a wide range of sectors from construction and packaging through to the automotive industry. However, there is scope for new approaches to the way in which the metal is processed. The potential of anodisation has not yet been fully exploited and innovations are still possible. Increasing competitive pressure is leading companies to look for new ideas for innovative, cost-saving processes that will allow them to become market leaders in the face of global competition. Attempting to introduce improvements in well-established industrial procedures may not seem worthwhile at first sight. However, a close investigation and evaluation of the individual stages in each process can help to identify opportunities not only to reduce costs, but also to increase productivity.

The anodising process is a good example of how this can be achieved. It is far more than simply a means of improving the appearance of aluminium. The anodised coating that is formed by the standard process produces an attractive, even surface and provides long-term protection. Around one third of the coating is deposited on the surface of the aluminium and two thirds of it penetrates into the metal. Because anodised aluminium is easy to process, alongside all its other excellent properties, it is a highly versatile material

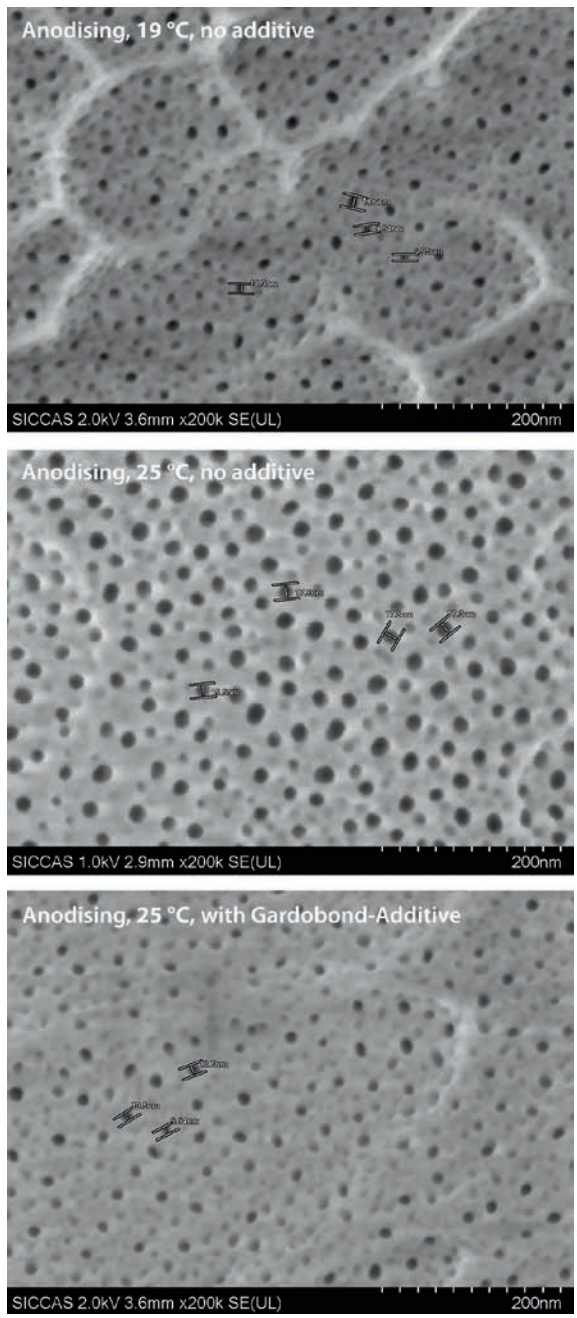

Figure 1 > Despite the higher anodising temperatures, the use of the GBA H7526 additive results in the same surface structure/quality (bottom) as with the standard parameters (top), in comparison with the poorer surface quality at high anodising temperatures without the additive (centre).

which is suitable for a wide range of different applications.

Decisions on a case-by-case basis

A re-evaluation of the tried-and-tested stages in the industrial anodising process is well worthwhile, because modifications to the process have proved in practice to be very good alternatives. This article sheds light on opportunities for improving anodisation. Reports and case studies from customers throughout the world illustrate the successful practical implementation of these new approaches. However, the choice of which process is most appropriate for each application must be made on a case-by-case basis, because individual tests to determine the suitability of the process need to be carried out first. The focus is on opportunities for saving energy and increasing productivity by shortening the time needed to apply and seal the anodised coating.

Improving productivity at the expense of quality

Over the years many anodising companies have attempted to improve their productivity by increasing the overall number of components processed each day. Often the batches are simply made larger without changing other important factors such as the cooling system. However, in many cases enlarging the batch size often leads to a fall in the current density, which plays a crucial role in the surface quality. The factors with the greatest influence over the quality, productivity and cost are the process temperature, current density and anodising voltage.

In general terms, higher temperatures lead to pores with a larger diameter, which results in less aluminium oxide being produced and therefore a softer coating being created. The same effect can also be caused by a lower current density, a higher voltage or a high or excessive acid concentration. Coatings with larger pores are usually easier to dye, but in many cases are more difficult to seal and provide less effective corrosion protection. They are also generally less resilient, because the anodised coating is too soft. The reverse is also true. Lower temperatures and/or higher current densities and lower voltages often result in smaller pores, which means that the coating is more resistant and of better quality.

Additive increases tolerance to dissolved aluminium

How can the efficiency of the process be improved while at the same time reducing the direct costs of anodising? Is there a possibility of accelerating the anodising process in order to improve productivity without having a negative impact on the structure and quality of the coating?

In theory it is easy to improve productivity by increasing the current density, if there is sufficient rectifier capacity available. However, a high current density and the necessary increase in the anodising voltage can produce a large amount of heat, which leads to a soft coating and even to burning. As a result, additional cooling is needed.

It is now possible to use modern additives in the sulphuric acid in the anodising tank. Chemetall has developed an innovative product in its Gardobond range. The additives are a further development of oxalic acid and reduce the re-dissolving rate during the anodising process and increase the tolerance to dissolved aluminium. This makes anodising possible at a higher temperature, with a higher aluminium content and a higher current density at the same voltage or with the same current density at a reduced voltage.

When added to the anodising bath, the new, highly efficient additives produce a very homogeneous surface finish and reduce the sensitivity of the anodising process to aluminium and high temperatures. The Gardobond H 7526 additive results in perfect quality coatings with a high aluminium content (a maximum of 30 g/l), a higher temperature (a maximum of 30°C)

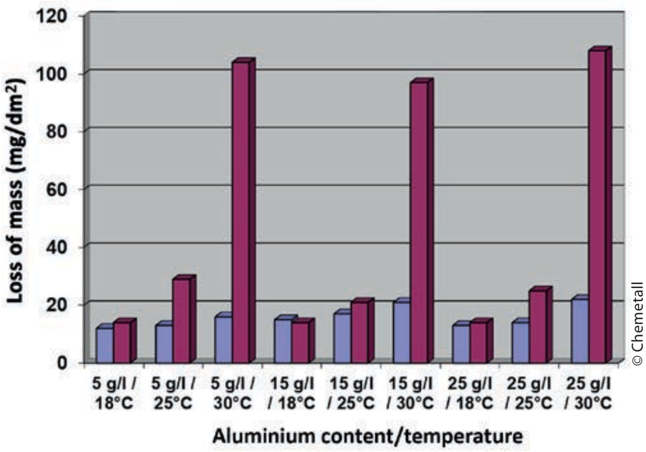

Figure 2 > Opportunities for improving coating quality in the anodising process with and without additives using the example of the measurement of the loss of mass in accordance with ISO 3210.

An overview of the benefits of the new additive

- Increased productivity as a result of the reduction in the anodising time
- Energy savings of up to 40 percent and therefore lower energy costs (electricity and cooling)
- Easier disposal of the filter cake because of the low concentration of sulphuric acid in the waste water
- Improved surface quality caused by the higher process temperature

and a lower concentration of sulphuric acid. When the process temperature is increased, the anodising voltage can be reduced to achieve a specific current density. For example, at 1.5 A/dm² a reference laboratory test produced the following results:
19°C – 18 V, 25°C – 15.5 V, 30°C – 14 V. This indicates that a significant energy saving is possible. In addition, almost the same amount of cooling energy is used. The correct additive can lead to a 40% reduction in energy consumption.

Shorter anodising times

The speed of the anodising process produces other possible effects. If a thicker coating is needed when anodising using standard parameters, for example in architectural applications, as the thickness of the coating increases so the process slows down until the coating cannot become any thicker, because the formation of the coating and the acid attack are in balance.
The empirical formula for the calculation is as follows:

Thickness (µm)
= 0.3 × current density (A/dm²) × time (minutes)

Given a standard current of 1.5 A/dm² the figures in practice are:
10 µm anodised coating = approximately 18 minutes, 20 µm anodised coating = approximately 40 minutes. The formula makes it clear what effect an increased current density can have in terms of improved productivity (by reducing the time needed).
Another possible side-effect is a longer-lasting bath. Increasing the maximum tolerance to aluminium in the anodising bath means that it will need to be replaced less often, which will lead to reductions in the volume of acidic waste water and in the amount of fresh water that has to be added. It may also be possible to reduce the consumption of sulphuric acid, which will lower the overall volume of waste water, because the quantity of acid carried over into the rinsing baths will also be decreased.
However, the most important technical effects of the modified anodising process are the significant improvement in the surface and sealing quality.
Higher anodising temperatures cause more of the coating to dissolve as a result of the acid attack, with the consequence that the diameter of the anodic pores increases. However, the proportion of oxide in the coating falls and therefore the overall quality of the coating is significantly impaired. This has a negative influence on the sealing quality and on the coating's resistance to abrasion and corrosion. The use of a suitable additive can counteract all of these effects. *Figure 1* shows the surface structure at different temperatures and aluminium contents. Using the innovative additive, the pore size is the same size at 25°C as it would be in a bath without the additive at 19°C.
The consequence of this is that the additive can bring about considerable improvements in the quality of the coating. *Figure 2* highlights the opportunities for improving the coating quality using the example of the measurement of the loss of mass in accordance with ISO 3210 in the anodising process with and without additives.
Anodising using the process developed by Chemetall is not only more efficient, but also improves the properties and advantages of the aluminium itself. //

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