4 | 2025 Volume 18 www.ist-surfacetechnology.com

Springer Vieweg

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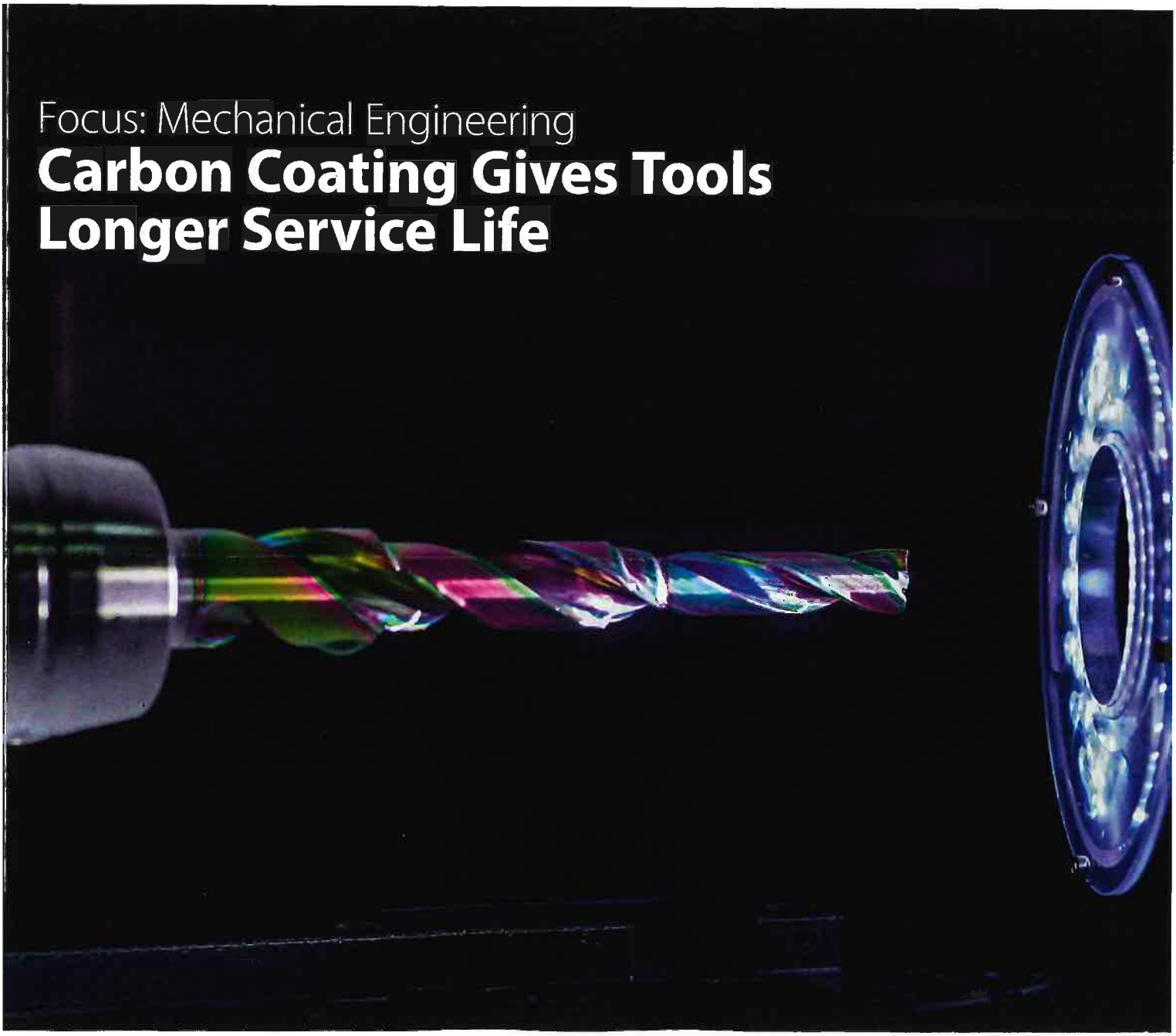

Not All Grinding Is the Same

In hygiene-sensitive areas, the cleaning behavior of surfaces plays a key role. Metal surfaces with the same roughness values can exhibit different adhesion behaviors depending on the grinding method used. A manufacturer of stainless-steel containers and special designs offers optimized surfaces for equipment and containers in the pharmaceutical, food, and process engineering industries.

Prof. Dr.-Ing. Arnulf Hörtnagl, Prof. Dr.-Ing. Paul Gümpel, Cornelius Mauch

In sensitive industries such as the food and pharmaceutical industries, technical terms such as EHDG and hygienic design are becoming increasingly important. The reason for this is that operators must avoid the spread of particles and the associated contamination of their batches at all costs. One of the decisive factors here is the cleaning behavior of surfaces, for example of equipment and containers, and the associated adhesion behavior of particles. But what factors influence the adhesion of particles to hygienic surfaces and how can these factors be optimized? [1]

Figure 1 > The company from the Allgäu region manufactures customized stainless-steel products, such as transport containers.

Bolz Intec GmbH from Eisenharz/Argenbühl (Germany), which has been producing containers and special constructions made of chrome-nickel steels for many years (*Figure 1*), asked itself precisely these questions and investigated the properties of surfaces in several years of research in cooperation with the University of applied Science Konstanz (HTWG). In addition to the usual roughness profile of surfaces, which is currently used in most industries as the main characteristic for describing surface quality, other factors such as the final surface energy have also been examined in more detail.

The current state of the art is the assessment of surfaces using non-destructive testing, such as roughness measurement in conjunction with optical testing. However, there are other criteria that should not be ignored. Among other things, the way in which the surface is finished should be taken into account. It was found that different grinding methods exhibit different adhesion behaviors in the final assessment of the surface, even though the Ra value of both surfaces is the same. It was now clear that the way in which the material is removed plays an important role here. As an experiment, contrary to the usual manual grinding, the container was ground using an automated grinding process over a long period of time. This fine removal over a longer period of time resulted in less adhesion and thus better cleaning. [1,2]

Bolz Intec has utilized the findings from these studies and developed a process in which the aforementioned low, constant removal rate is achieved over a long period of time in a semi-automated manner. The process has been named Optimized Grind Finishing, or OGF for short. The removal in the container is achieved with geometrically undefined abrasive media that move inside the container. A major advantage of this process is that the surface is not only high quality but also reproducible. It is independent of undefined variables, such as the manual contact pressure applied by an employee during conventional grinding or the quality of individual abrasives. It was important to Bolz Intec that the end result was a defined roughness depth with little influence on the depth of the structure and a visually appealing surface.

As can be seen in *Figure 2*, these differences are also visible to the naked eye. For comparison, a surface produced using the conventional grinding process was used and compared with the OGF process. In this study, the surfaces were examined using an optical 3D measuring system in accordance with DIN EN ISO 25178 and visualized using a false color representation. This shows that there is no linear grinding direction with the OGF process. As a result, the height differences on the surface are significantly smaller than on the comparison model.

This is shown in *Figure 3* using a roughness measurement. Further changes were visible under the electron microscope, as can be seen in *Figure 4*. With the conventional grinding process, ir-

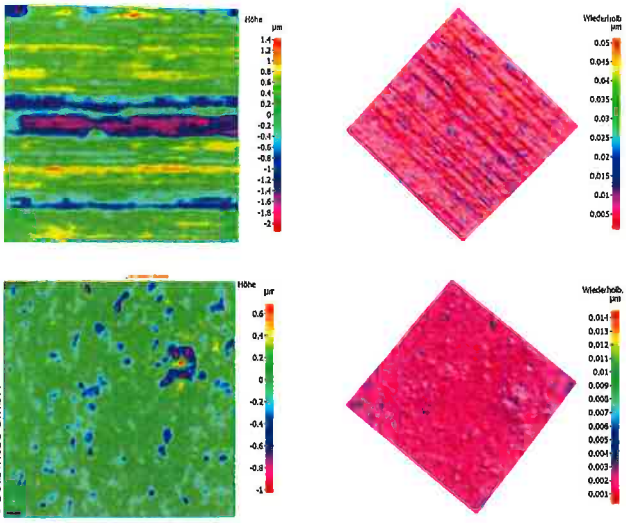

Figure 2 > 3D representation of mechanically finished surfaces – conventional grinding technology at the top, OGF process at the bottom.

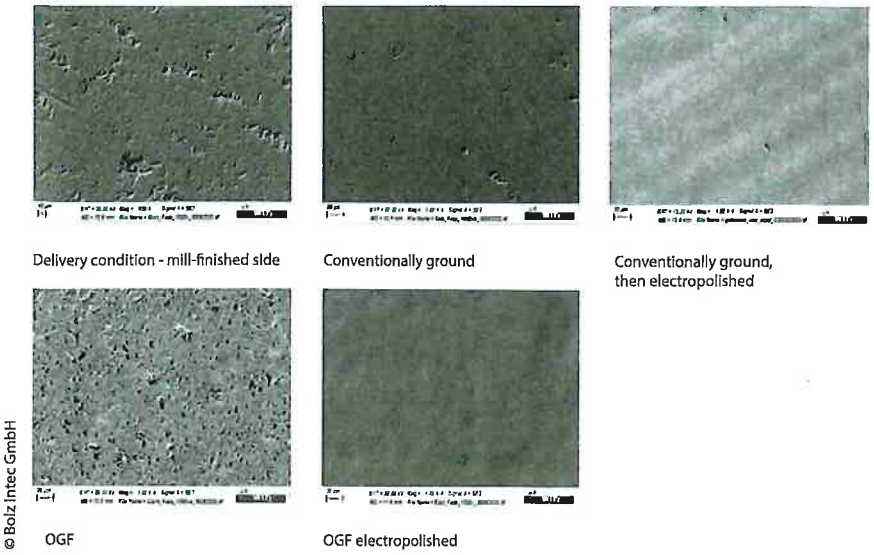

Figure 3 > Influence of the machining process used on the surface topography produced (electron microscope image).

regularities occur in the surfaces. These defects are significantly reduced by the very fine and gentle removal of material in the OGF process.

In the further course of the investigations, Bolz Intec further refined the ground surfaces and subjected them to an electropolishing process. This further removes the peaks in the surface structure, which, in addition to optical advantages, also brings about chemical changes, such as improved corrosion protection through a reinforced passive layer. In the final assessment of this investigation, the improved cleaning performance was demonstrated using a test based on VDA 19.1 (March 2015) / ISO 16232 (December 2018).

The OGF process visibly reduces residual dirt adhesion in containers, offering operators the added value of significantly reducing the risk of contamination of their batches. Bolz Intec has thus verified the parameters promoted at the beginning of the investigations and, with the help of research, has generated a surface that can be reproduced with repeatable accuracy in terms of both its roughness profile and visual assessment.

In addition, this surface has advantages over the comparison model in terms of cleaning. This added value could be decisive, especially for critical, very valuable, or very fine particles. Examples of this would be industries such as nanotechnology, biotechnology, pharmaceutical technology, or any other industry where batch purity and the avoidance of contamination are crucial factors in production. //

References

[1] Gümpel P. et al.: Rostfreie Stähle, Renningen, 2015

[2] Turnbull, A.; Mingard, K.; Lord, J. D.; Roebuck, B.: Sensitivity of stress corrosion cracking of stainless steel to surface machining und grinding procedure. In: Corrosion science 53 (2012), Nr. 10, S. 349-355

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