# Perfect surface finishes for 3D-printed components

**Most 3D printed components initially have a very rough surface which needs further processing such as polishing to achieve the desired degree of smoothness. A new post-production process has been desgined to solve this problem.**

*Text & images by Walther Trowal*

Most 3D printed components are produced by placing material layers on top of each other, creating a 'staircase' effect on their surface with, generally, a very high initial surface roughness. Markings caused by the removal of support structures and sintered-on powder residue must also be removed before the components can be further processed or utilized. For this reason, many components must undergo a surface smoothing or polishing operation. Walther Trowal developed the 'AM post-process machines', model range AM, especially for refining the surface of components produced with additive manufacturing. The experience of the first customers using these machines shows that the mass finishing technology creates surface finishes in a single step, which meet the highest demands.
Mass finishing has proven to be the ideal surface finishing method for 3D printed components: these are completely embedded in the moving grinding media so that the process is very gentle and produces homogeneous and repeatable surface finishes. Moreover, the media also reaches internal passages and undercuts in the components.

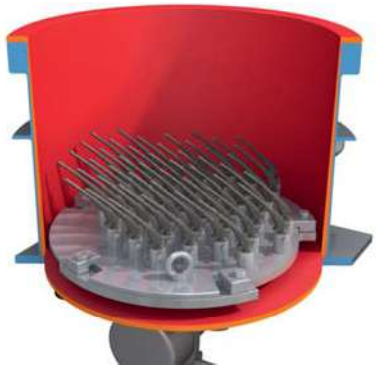
## The AM post process

Depending on the size of the processing bowl, up to 100 small workpieces or single components with a size of 900 x 500 mm can be treated in the AM model range of the new 'multivib' vibrators. The workpieces are mounted on a carrier plate, which is then mechanically or electromagnetically clamped to the bottom of the processing bowl. The media is added to the processing bowl, and compound and water are continuously added during the process. Three vibratory motors induce an intense vibration into the processing bowl. Since the vibratory movement generated by the motors is overlapping, the component surface becomes smoother, while the edges are left intact. After a pre-determined cycle time, the process is complete and the finished workpieces removed.
Several manufacturers of automotive, aircraft and medical components are already using the new AM multivib vibrators, which reduce the surface roughness of the raw workpieces from around Ra = 2 to 80 µm down to a value of 0.025 µm.
Maximilian Beien, sales manager at Walther Trowal, considers additive manufacturing and mass finishing a perfect match. "Additive manufacturing and mass finishing are an ideal combination because most 3D printed components must have an excellent surface finish to fulfil their function. For example, turbine blades require an airflow with minimal friction loss. Components with stringent specifications for hardness and strength benefit from the homogeneous peening effect induced by mass finishing. This finishing method is especially advantageous for 3D printed components with bionic shapes."
Mass finishing is suitable for a wide range of materials utilized in additive manufacturing, for example, for high performance, difficult-to-machine metals like titanium, nickel-based or cobalt-chrome alloys. Walther Trowal grinding media and other consumables are already approved for many materials and safety-relevant components and processes.
Beien points out the high cost-efficiency of the 'trowalizing' process in conjunction with additive manufacturing: "Compared to electro-chemical finishing methods, mass finishing achieves the desired surface smoothness and luster in a single operation. Another advantage is that the mass finishing equipment is very compact with a small footprint. The result is an excellent surface finish, surprisingly short cycle times and an overall high cost-efficiency, not only with regard to the capital expenditures but also the operating costs."


*The multivibrators of the model range AM were specifically developed for finishing the surface of 3D printed components.*

*A 3D printed blisk segment before (left) and after the 'trowalizing' process.*

*A 3D printed metal baffle before (left) and after the 'trowalizing' process.*



*The workpieces are mounted onto a carrier plate, which in turn is electromagnetically clamped to the bottom of the processing bowl.*

## A proven finishing method

Topologically optimized workpieces with complex shapes often have difficult-to-reach internal passages. Manual finishing of these surface areas is not possible, especially when the pieces are subject to strict safety and manufacturing standards, for example in the aerospace industry. Moreover, 3D printing is used for serial manufacturing with continuously increasing production volumes.
Christoph Cruse, general sales manager at Walther Trowal: "A lot of things are going on in the field of additive manufacturing. For example, the production process must be optimized for many workpieces. Many customers are pleased to learn that they do not have to invest in additional development efforts but can rely on the proven 'trowalizing' finishing technology." The optimum parameters for the finishing process are, jointly with the customers, determined through processing trials conducted by the process engineers at the Walther Trowal test center. This also includes the selection of the most suitable grinding or polishing media and compound.
Based on his many years of experience, Michael Becker, the manager of the Walther Trowal test center, gladly shares his knowledge. "Compared to other finishing systems, the single-stage process facilitates and shortens the surface finishing operation significantly. Of course, the finishing operation can be further optimized, when all surface treatment considerations are already taken into account during the design phase for the 3D printed components and the parameterization of the printer. For example, this applies to determining the material layer thickness and the material feed rate of the printer. We gladly support our customers in resolving these issues."
Although additive manufacturing has already established itself as a system for volume production, there is a lot of potential for further technological improvement. To maintain its leading role in the field of surface finishing, Walther Trowal cooperates closely with the Direct Manufacturing Research Center (DMRC) at the University of Paderborn/Germany. To enable both project partners to conduct empirical studies, an AM-2 'multivibrator' was installed at the Paderborn location.

### About Walther Trowal

Since 1931 Walther Trowal has been developing and producing systems for the refinement of surfaces. Initially focusing exclusively on mass finishing, over time, the company has developed a broad range of machinery and systems for mass finishing, shot blasting and coating of mass-produced small components.