Life-cycle assessment of the LPBF process

Sustainability for LPBF in industry

Additive manufacturing processes such as laser powder bed fusion (LPBF) have reached a high level of technological maturity in recent years and are increasingly being used in series production. As far as its sustainability is concerned, the process offers advantages: functionally optimized components can be manufactured near-net-shape and resources can be saved: among others, the unmelted metal powder can be reused. These positive properties of additive manufacturing fulfill the requirements of sustainable production since they increase resource efficiency and recycling management, and reduce energy consumption. The additive process, therefore, has the advantage over subtractive processes as it produces lower emissions.

Merging of LCA to LPBF

In addition to costs and component quality, a product's ecological footprint will be an important evaluation criterion for manufacturing technologies in the future. Manufacturing companies are increasingly accepting their responsibility to reduce environmentally harmful emissions; however, implementation often fails since the emissions LPBF generates cannot be accurately measured. Life-cycle assessments (LCA) of components generate a deeper understanding of how individual process steps influence the sustainability of manufacturing and help to identify relevant parameters. Previous LCA studies have only insufficiently considered the LPBF process chain.

Life-cycle assessment using the example of a manufactured LPBF component

In this area Fraunhofer ILT is cooperating with the powder manufacturer 6K Additive (Burgettstown, PA, USA). In a joint study, industrially relevant components are being manufactured using a powder made from recycled IN718, and the partners are analyzing the process in terms of sustainability. For this purpose, they are not only collecting primary data on material and energy flows on LPBF systems before, during and after manufacturing, but also analyzing and integrating it into a software-based LCA model. This way, they can balance the ecological footprint from material production to the additive manufacturing process as a whole for the first time, and identify possible levers for further improving the ecological efficiency of the process.

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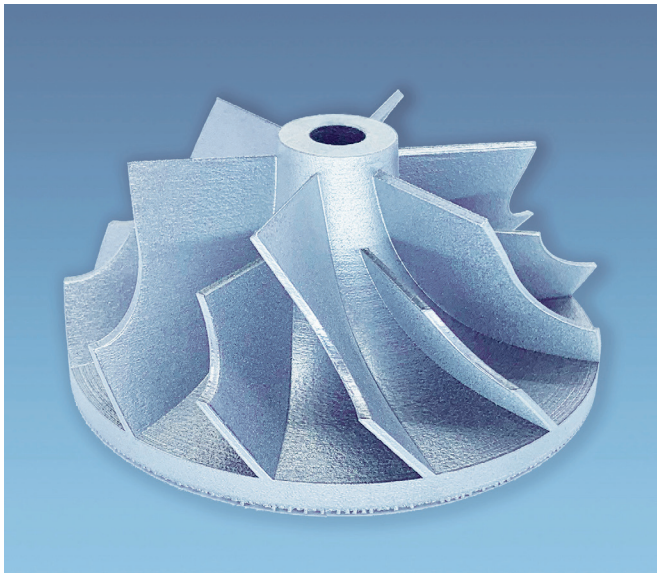

Additively manufactured impeller for an LCA study on LPBF.

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