



Pilot impeller during coating process (source: SiCcast GmbH).

# Wear- and corrosion-resistant stirrer for fermenters in biogas plants

**Dr.-Ing. Steffen Kunze, Dipl.-Ing. Anne Deutschmann**



Pilot impeller on a trade fair stand after the two-year application test.

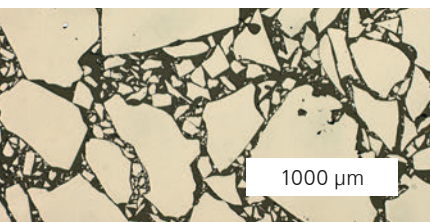
Due to the complex characteristics of the fermentation substrates, stirrers made of metallic materials, plastics or glass fiber reinforced polymers only achieve service lives of a few thousand operating hours. In addition to the increased maintenance effort, it is problematic that the wear and corrosion of the stirrer, which already sets in after a short operating time, negatively affects the mixing process in the fermenters. The main requirements for stirrers are determined by the chemical (pH value, heat of reaction, high salt content,  $H_2S$ ), mechanical and tribological conditions in the fermenter.

The impeller showed extremely low wear over the course of this period and confirmed the tests in the laboratory scale. The results indicate that such reinforced fermenter stirrers can be used in continuous operation in biogas plants for more than 10 years without any significant loss of stirring performance.

Image 4 shows scaled impellers after the tribotests. Stirrer (PA 12) in its initial state (left), stirrer (PA 12) after the high wear test (right), stirrer coated with the developed reinforcement after the wear test (center).

### Services offered

- Characterization, development and optimization of agitators
- Material development of ceramic-based wear protection coatings
- Characterization of tribological and corrosive effects
- Manufacture of sample components



Typical material structure of the polymer-ceramic composite (source: SiCcast GmbH).

As part of the joint project "MaRüFerm", Fraunhofer IKTS, together with the agitator manufacturer RTO GmbH and the mineral casting specialist SiCcast GmbH, developed a wear-resistant coating for fermentation stirrers. It consists mainly of a cold-curing polymer-ceramic composite that can be applied in variable layer thicknesses to metallic, ceramic and polymer materials. This coating technology allows not only new stirrers to be reinforced, but also already worn agitator equipment to be refurbished in a time-efficient and cost-effective manner.

The polymer-ceramic composite has a very high media stability and no fouling tendency. Thanks to its strong damping properties, it is damage-tolerant and insensitive to impacts despite its high ceramic content. In a tribotest on scaled impellers, the reinforcement showed a wear rate lower by a factor of 5 compared with stirrers made of polyamide 12.

Technological testing took place in a two-year long-term test of a reinforced industrial pilot stirrer (Ø 2500 mm, speeds of up to 60 rpm) in a biogas plant.



Propeller with (center) and without coating (right) after tribotests in the laboratory.



on the basis of a decision by the German Bundestag