



Ceramics in Abrasive Applications like Milling and Mixing

Dr. Thomas Werninghaus
Senior Business Development Manager
Kyocera Fineceramics Precision GmbH

Outline

- ▶ Kyocera
- ▶ Materials
- ▶ Motivation
- ▶ Benefits of Technical Ceramics in Mixing and Milling
- ▶ Outlook





KYOTO

CERAMICS

Kazuo Inamori
Founder and Chairman Emeritus
KYOCERA Corporation



Funded in 1959
by Dr. Inamori
in Kyoto, Kyocera
contributes to our society
with **comprehensive capabilities**
that enhance everyday life

Devices & Equipment



Information & Communications

Automotive

Environment & Energy

Medical & Healthcare



Materials

Aluminum Oxides

- Black Aluminum oxide
- Various purity levels:
93%, 96%, 99%, 99.5%, 99.9%, 99.99%

Other Oxide Ceramics

- Aluminum Titanates
- Zirconium Oxides
- Forsterites
- Ferrites
- Steatites
- Mullites
- Cordierites

In total more than 200
material variants

- Silicon Carbides
- Titanium Carbides
- Silicon Nitrides
- Titanium Nitrides
- Aluminum Nitrides

Non-oxide Ceramics

- Cermet
- AlTiC
- Piezo Ceramics

Compound Materials



Motivation

Why applying technical ceramics to replace metals in mixing and milling?

- ▶ Improving cost-effectiveness and process performance
 - Components lifetime
 - Process stability
 - Process repeatability
- ▶ Increasing requirements for powders production as raw materials
 - Purity
 - Metal (especially iron) content reduction
 - Particle generation
- ▶ Conflict-material free supply chain



Benefits of Technical Ceramics in Mixing and Milling

► Mixing

- Blades
- Stirrer
- Grinding jars
- Homogenizer (food industry)



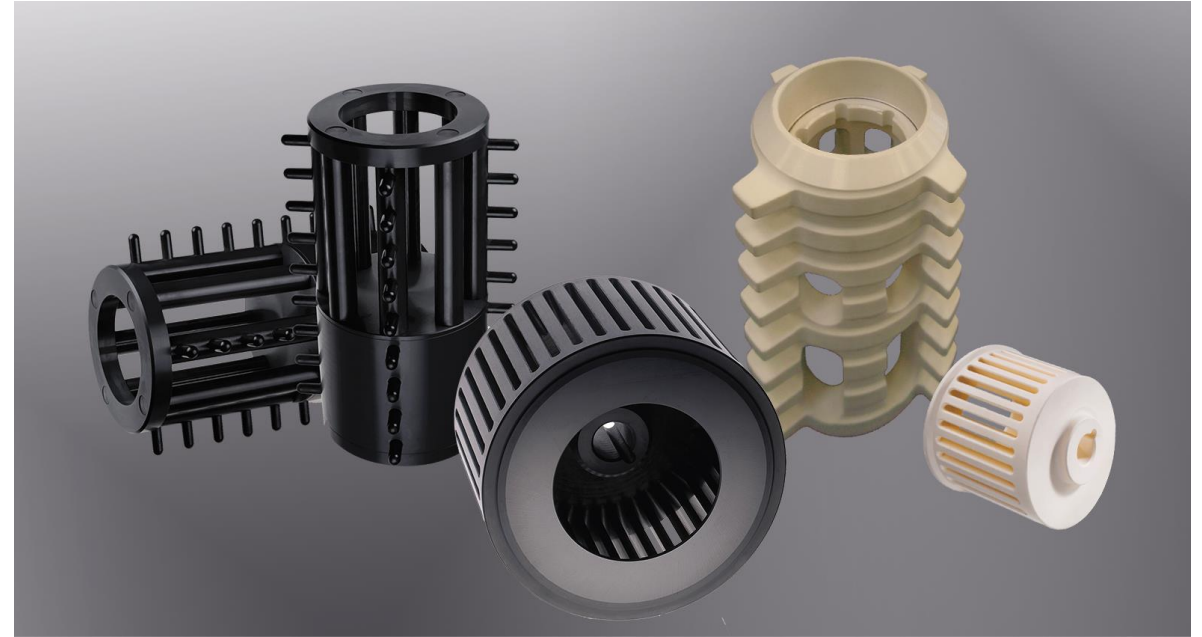
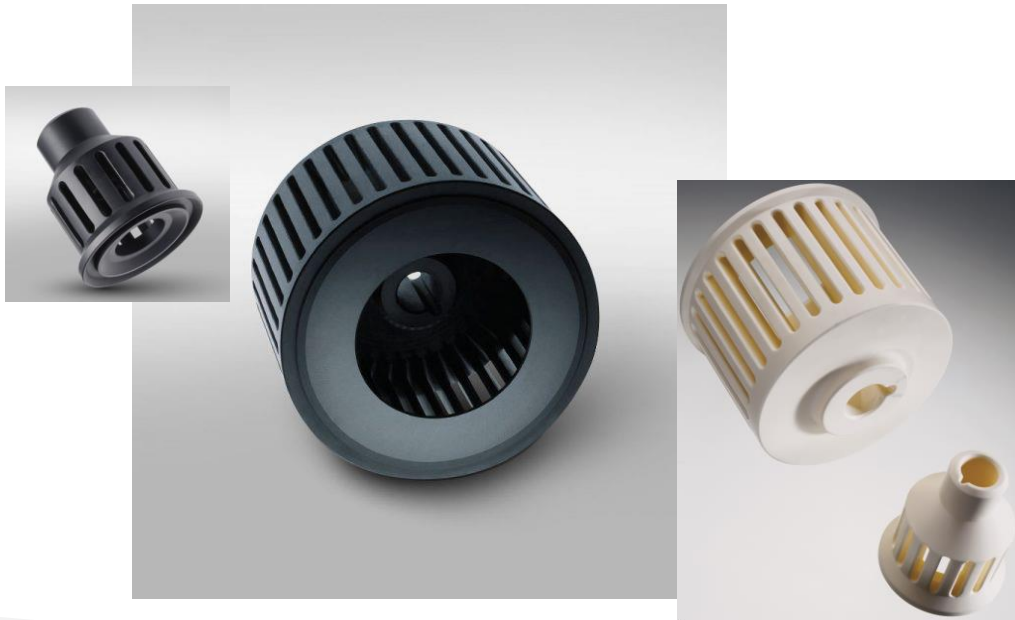
Source:
www.ekato.com/solutions/processes/highly-abrasive-processes/



Benefits of Technical Ceramics in Mixing and Milling

► Milling

- Liner (wet)
- Rotors (wet)
- Classifying / Separator wheels (dry)



Benefits of Technical Ceramics in Mixing and Milling

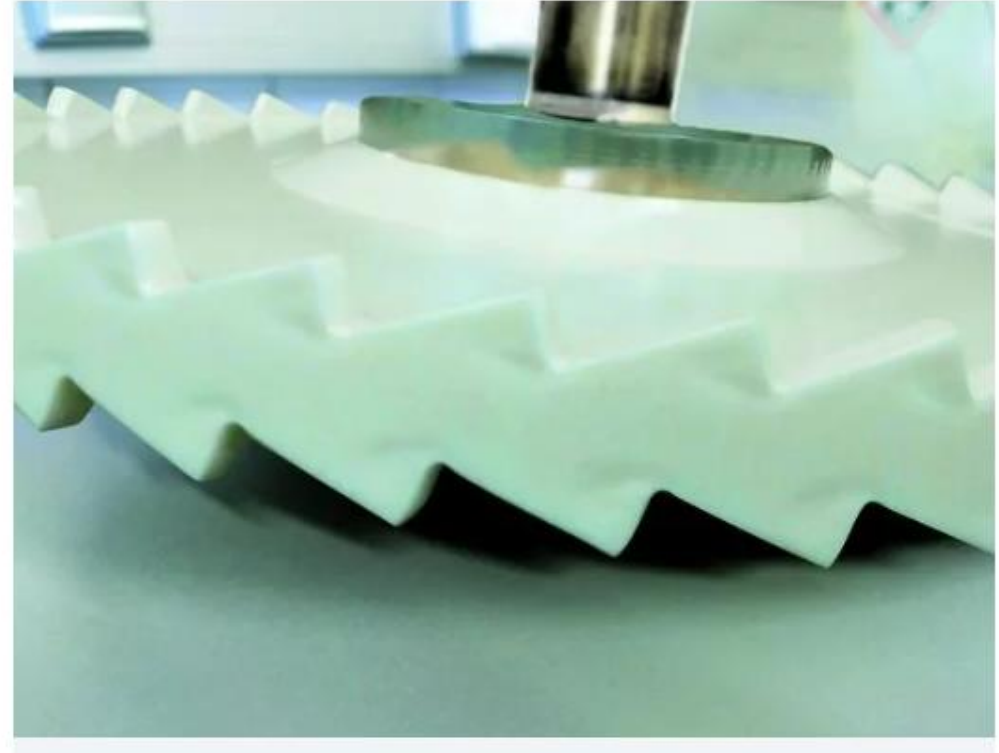
- ▶ Improving cost-effectiveness and process performance
 - Abrasion resistance
 - Longer lifetime with many months' uptime in highly abrasive environments
 - Excellent chemical resistance → applicable in chemical industry
 - Corrosion-free, FDA approved → applicable also in the food, medical and pharmaceutical industry



Benefits of Technical Ceramics in Mixing and Milling



Metal dissolver after 20 hours



Ceramic dissolver after 480hours (20days)

Source:
www.ekato.com/solutions/processes/highly-abrasive-processes/



Benefits of Technical Ceramics in Mixing and Milling

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 - Abrasion resistance
 - Longer lifetime with many months' uptime in highly abrasive environments
 - Excellent chemical resistance → applicable in chemical industry
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- ▶ Increasing requirements for powders production as raw materials
 - Almost zero particle generation
 - High purity and chemical stability with no reaction to processed powders → cleaner products for higher performance
 - No free metals, especially iron-free → Battery raw material preparation
- ▶ Highest Quality made in Germany in fully vertical integrated facility
- ▶ Replacing Conflict Material Dependence
- ▶ Stable roadmap and processes into future applications with finer particle requirements → Nano technology, new applications



Outlook

- ▶ Future applications with increased process requirements:
 - Nano milling technologies with narrow powder distributions for paints, pharmaceutical, ...
 - Electronics with contamination sensitivity on metals from abraded particles
 - E-Mobility (iron-free and higher homogeneity for lithium-ion batteries or new concepts)
 - Pharmaceutical and chemical industry on active ingredients distribution
 - Food industry on cleanliness and cross-contamination



Thank you very much for your attention

THE NEW VALUE FRONTIER



Dr. Thomas Werninghaus

Senior Business Development Manager
KYOCERA Fineceramics Precision GmbH
Lorenz-Hutschenreuther-Strasse 81
95100 Selb / Germany
Tel: +49 9287 807 179
Mob: +49 160 90709435
E: thomas.werninghaus@kyocera-precision.com

Visit us
@ booth 18-203