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LUBLIN UNIVERSITY OF TECHNOLOGY

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Patent Application No P. 438221 (2026)

Method for producing colored abrasive paste

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NANOTECHNOLOGY, MATERIALS AND ENGINEERING

TECHNOLOGY READINESS LEVEL: 5

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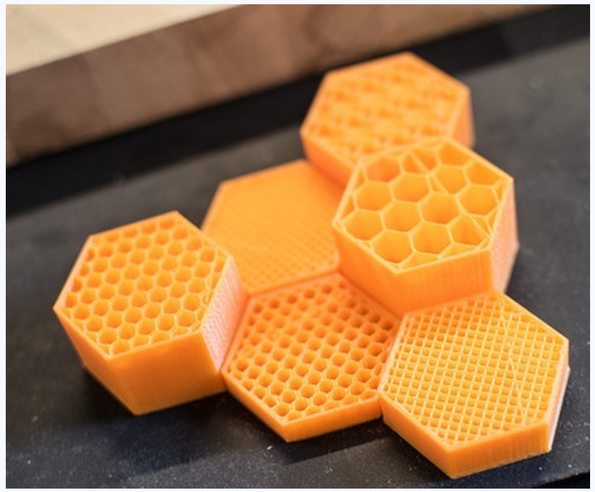
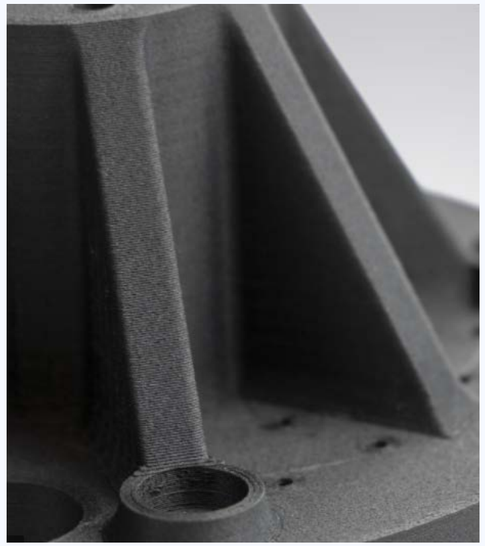
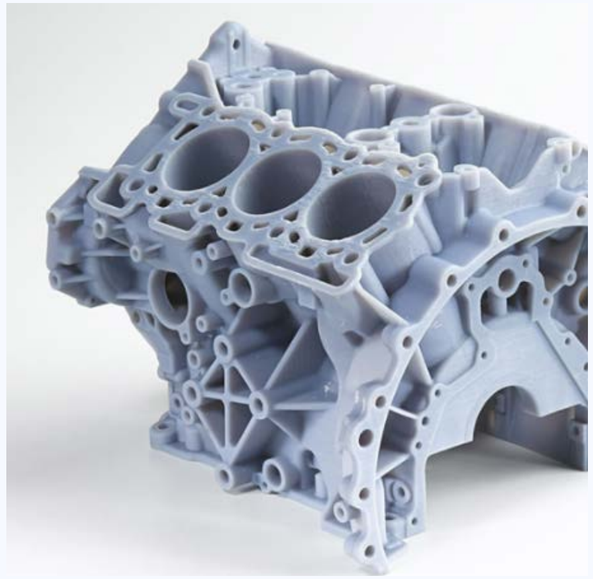
Introduction: 3D printing

The internal surfaces of 3D printed products' channels for the flow of fluids or gases require additional processing after their manufacturing process.







New Material- colored abrasive paste

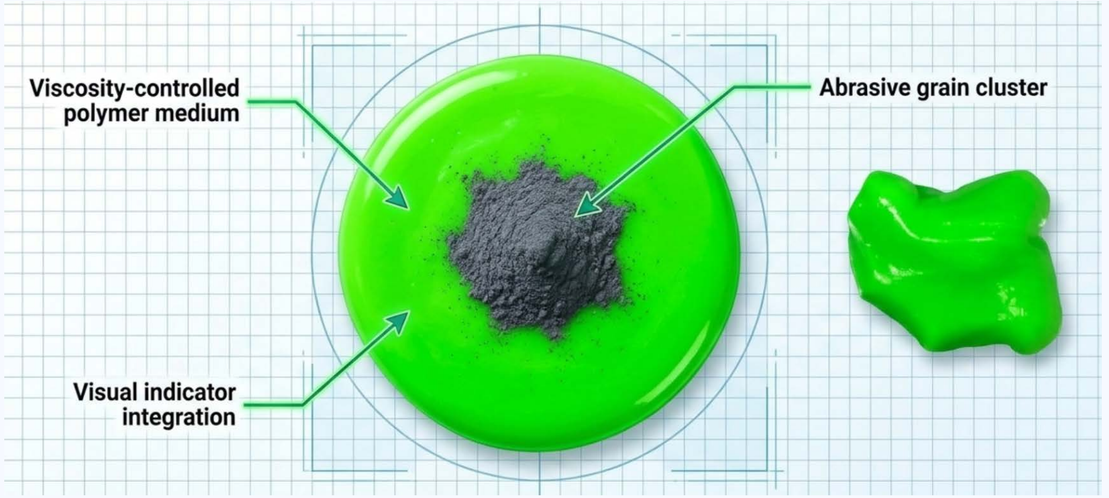
A shear-thickening paste is a non-Newtonian material

Implementation Method

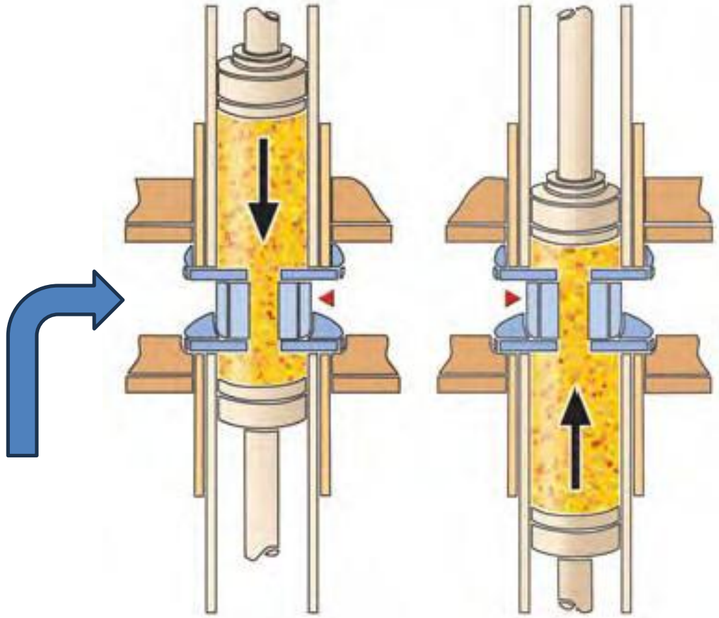
The solution involves developing a colored abrasive paste with controlled rheological properties and a visual wear indicator. Precisely balanced ingredient proportions (strictly defined volumetric ranges of reagents) ensure consistent physicochemical properties.

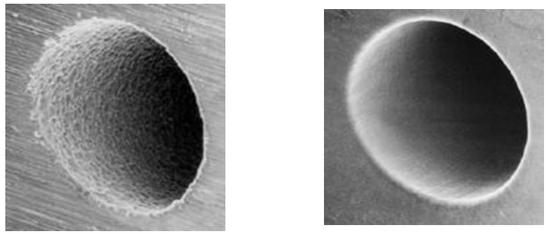
Abrasive grains (diamond or silica) with a wide range of grit sizes (14–1200 mesh) allow for customization for various applications.

Colored beads with a coating (paint or chrome) that change color during use provide a visual wear indicator.



The use of abrasive flow machining technology enables precise deburring and rounding of edges in hard-to-reach areas, including channels located within the workpiece.
Abrasive flow machining (AFM) technology fully demonstrates its advantages, especially when machining difficult-to-access and narrow tool flow channels.





internal canal before and after treatment with paste

Obtaining such surface quality is possible even with minimal machining allowances, as the "tool" in this case is a polymer enriched with fine abrasive grains, which, thanks to its flexibility, adapts to the shape of the machined surface.
Excess material is removed in the flow direction, enabling optimal machining parameters to be set during extrusion and pressure pressing of materials.

Preparation of abrasive colour polimer paste

Polish Patent Applicatio No P. 438221 (2026)

- Polysiloxane synthesis

$$n(CH_3)_2SiCl_2 + 2nH_2O \rightarrow n(CH_3)_2Si(OH)_2 + 2nHCl$$
$$n(CH_3)_2Si(OH)_2 \rightarrow [(CH_3)_2SiO]n + nH_2O$$

- Crosslinking of polydimethylsiloxane
  (50°C, 4% mass. boric acid)

$$[(CH_3)_2SiO]n + 2nB(OH)_3 \rightarrow [(CH_3)_2SiO \cdot B_2O_3]n + 3nH_2O$$

- Introduction of abrasive grains (diamond, silica)
  (5 - 60 %mass.)

The developed solutions, described as a method for producing an abrasive paste medium and an abrasive paste, as well as a method for producing a colored abrasive paste

separation of the aqueous phase from the ether phase

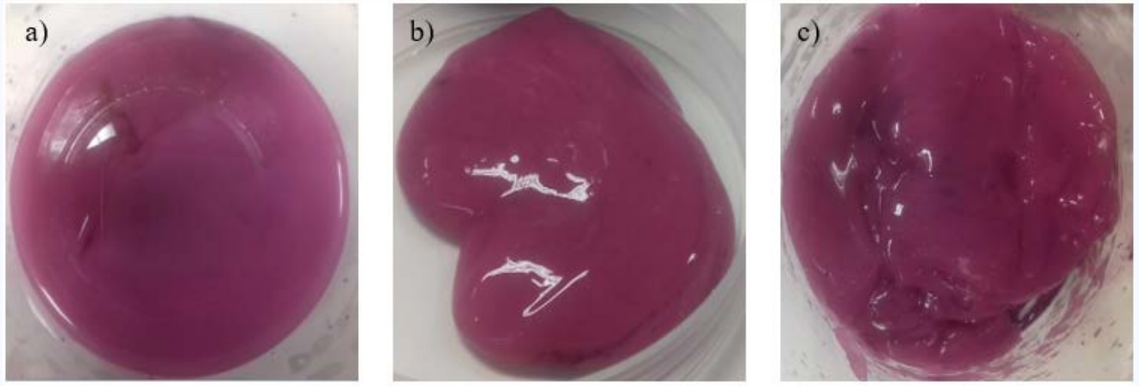
the process of cross-linking polysilovane

Viscoelastic properties of a polymer medium

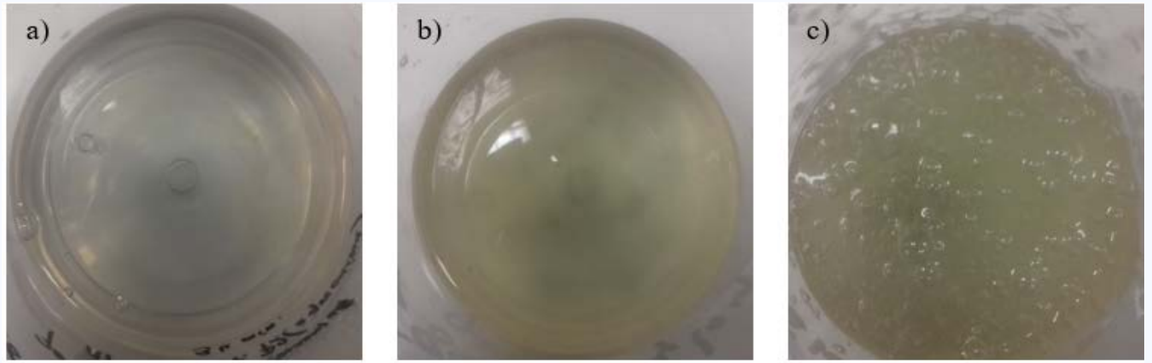
The viscoelastic properties of the polymer medium were determined by measuring the dynamic viscosity (η), the storage modulus (G'), and the loss modulus (G'').

Based on the obtained results, the influence of the crosslinking temperature (25; 50; 75°C) and the amount of crosslinking agent (2; 4; 6 wt.%) on the viscoelastic properties of the polymer medium was confirmed.

The most favorable properties were obtained using 4 wt% of the crosslinking agent and conducting the crosslinking process at 50°C.



polymer medium obtained at different concentrations of crosslinking agent: 2%, 4%, 6%



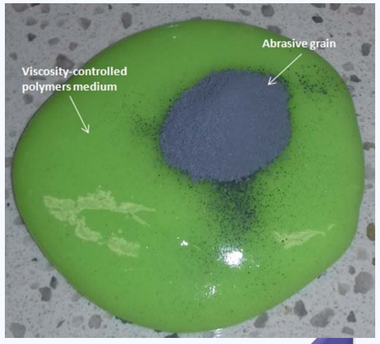
polymer medium obtained at different cross-linking temperatures 25, 50, 75 deg. C

A proprietary method for producing abrasive paste

polysiloxane polymer synthesis

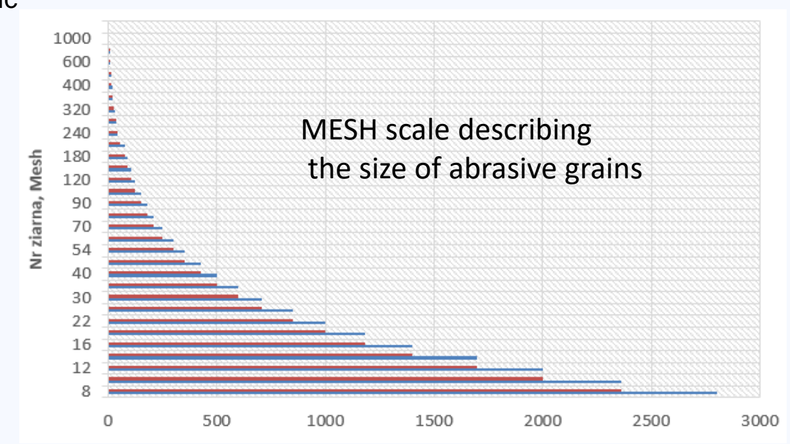
cross-linking of polysiloxan polymer

polysiloxane medium with specific viscoelastic properties



abrasive grain
+ polymer medium

a specially developed abrasive paste for processing plastic products



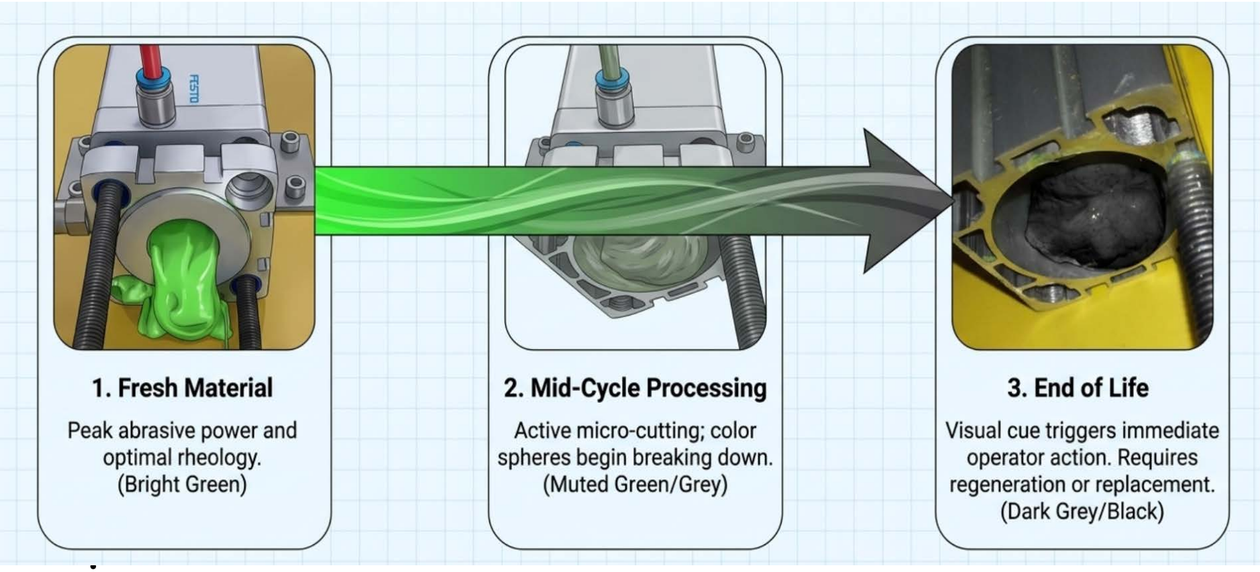
Abrasive grains: diamond

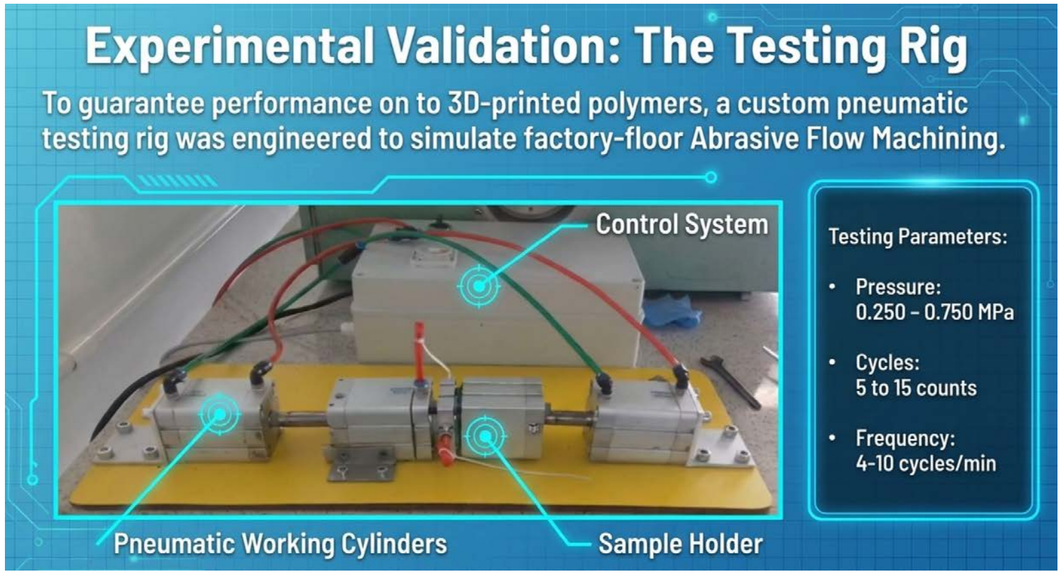
Abrasive grains: silica

Abrasive Paste –

New IDEA: Colored abrasive paste is a specialized material used in surface finishing processes that combines mechanical properties with advanced rheology, the science of how substances flow and deform. An interesting feature of the paste is its ability to change color during use.

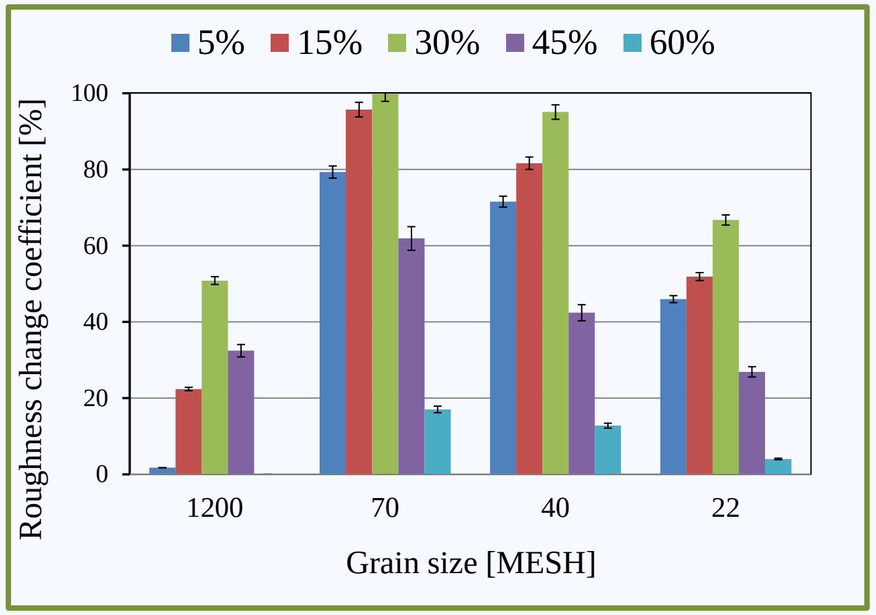
As a result of intensive abrasive transfer processing, visual changes occur, providing a simple indicator of wear. This allows the operator to assess when the paste needs to be replaced without the use of equipment



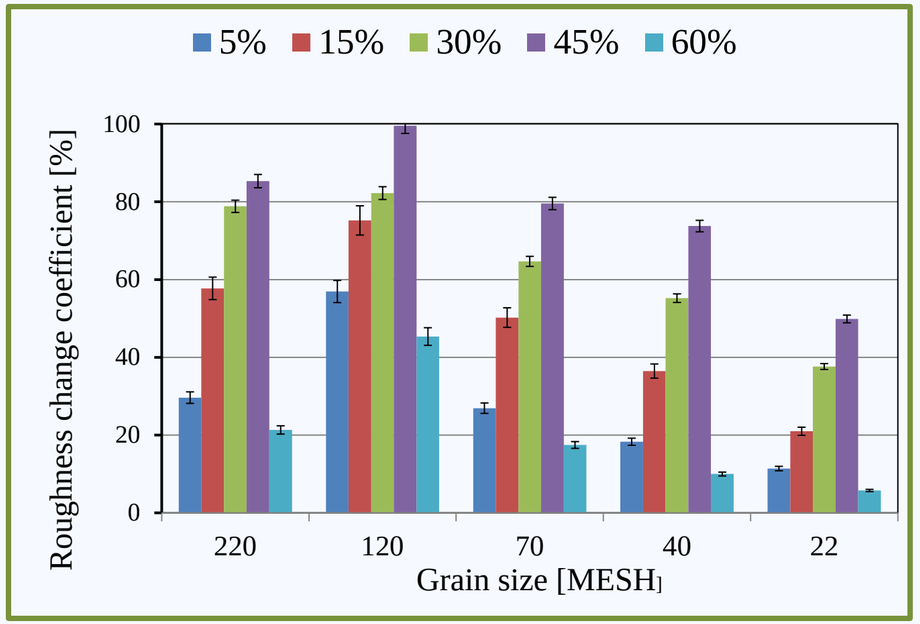


machines and paste during testing

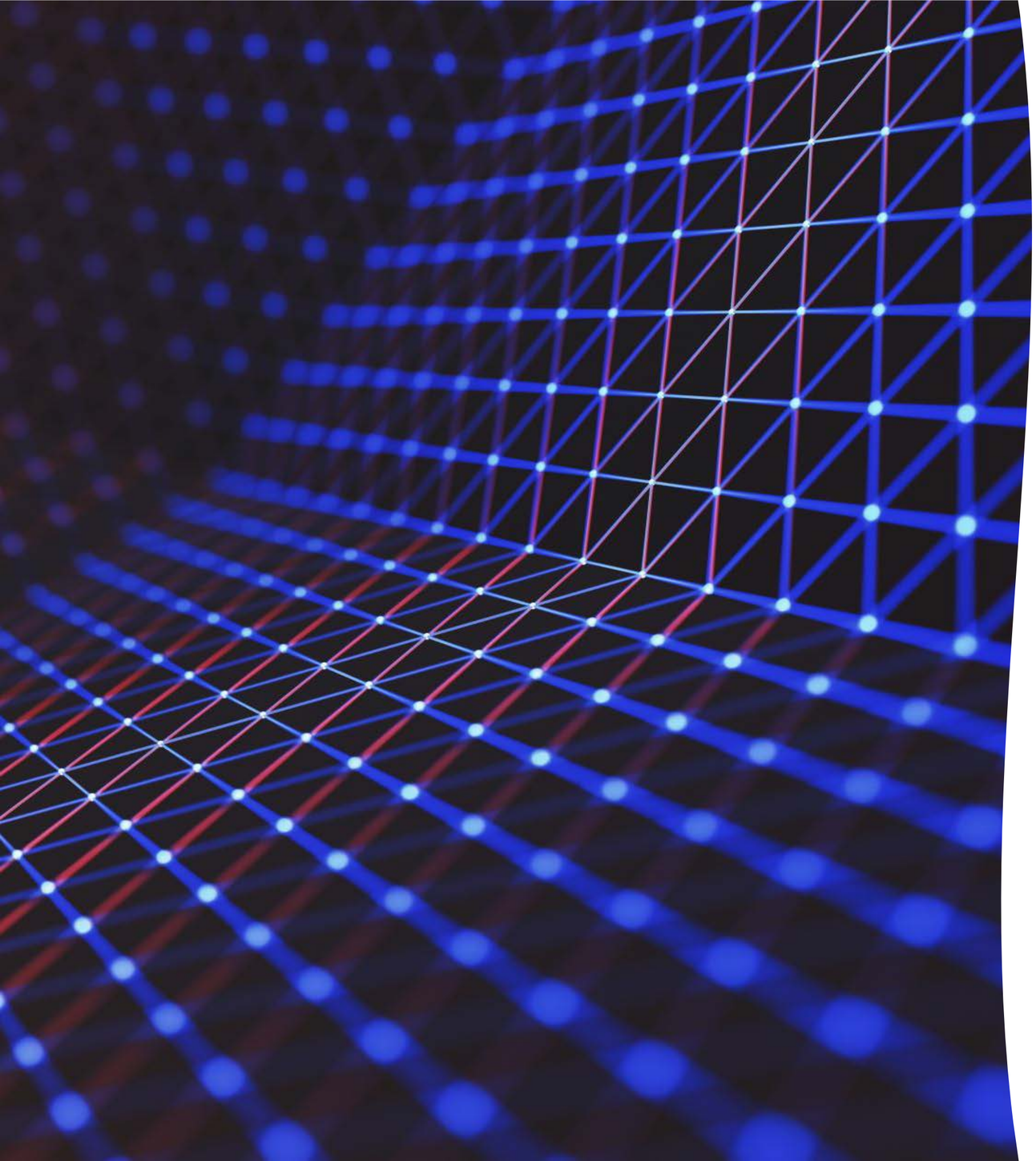
The Effect of Abrasive Grain Size on the Surface Roughness of ABS Products



Diamond grains: : 15–45% mass., 70–22 MESH



Silica grains: 5–60% mass., 220–22 MESH




Competitive Advantages colored paste:
• Visual wear monitoring
No need for sensors or laboratory analysis
Immediate operator decision-making
Advanced rheological properties
Viscosity *increases with* load → better process control
Stable operation under changing conditions
Regenerative capability
Reduced operating costs
Reduced waste

Conclusion

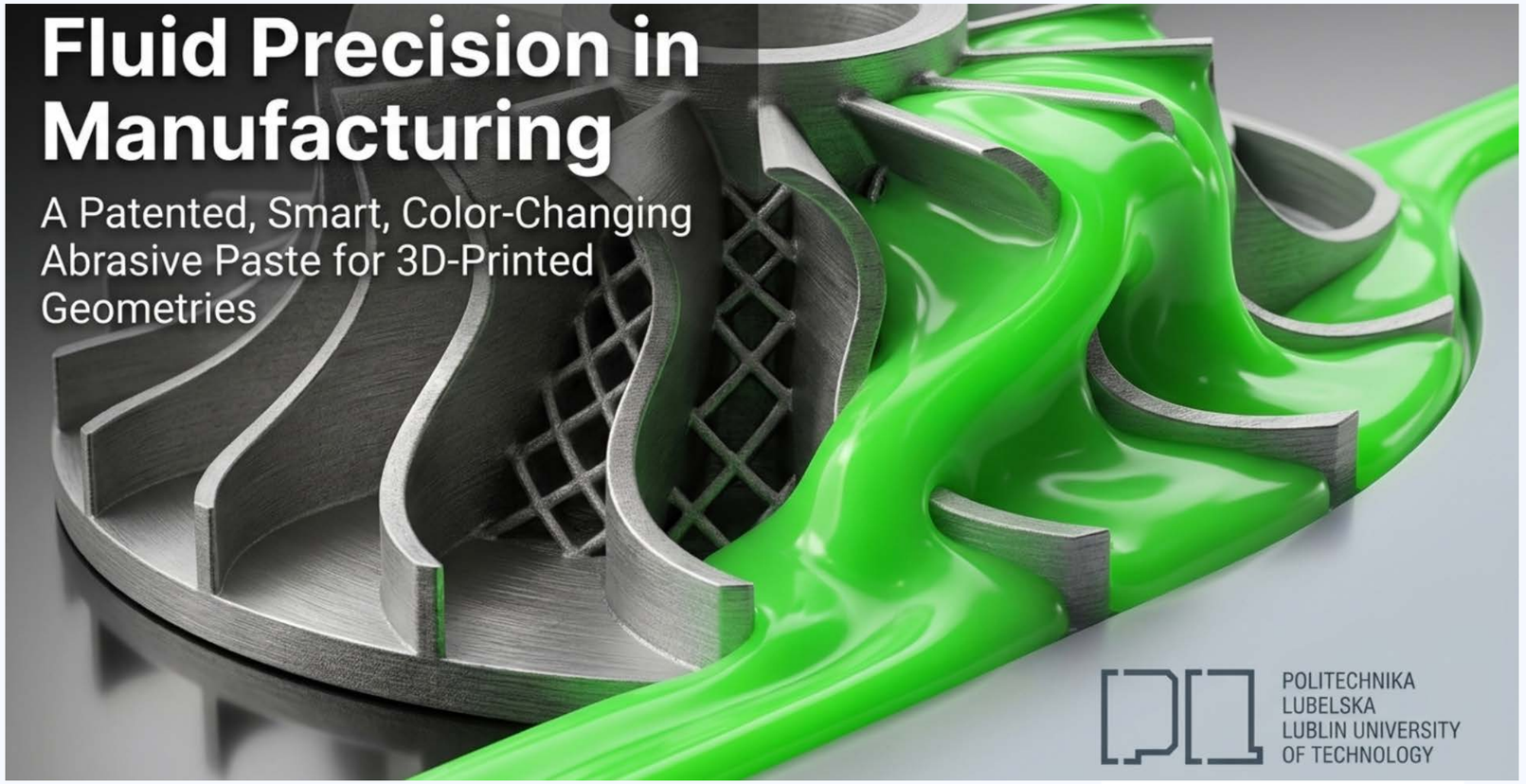
- An original formulation and method for producing an abrasive paste were developed, along with the design of an innovative test setup for evaluating the effectiveness of the AFM machining process on polimer products manufactured using 3D printing.

- The technology addresses a real industrial problem by combining material functions (controlled rheology) and information functions (color change).

- This increases process efficiency, reduces costs, and simplifies quality control.

- The resulting abrasive paste is characterized by stable and controlled physical properties. In particular, density and viscosity, which remain within specific ranges and are repeatable between production batches, designed carrier structure, the material exhibits rheological stability (shear-dependent viscosity) and chemical resistance, which translates into predictable behavior during use.

Thank You



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