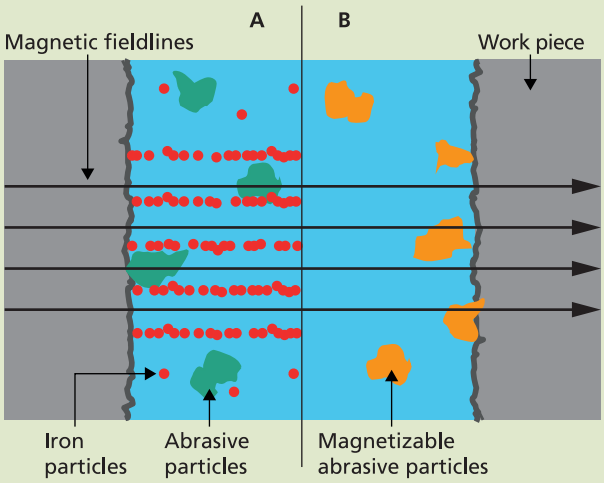

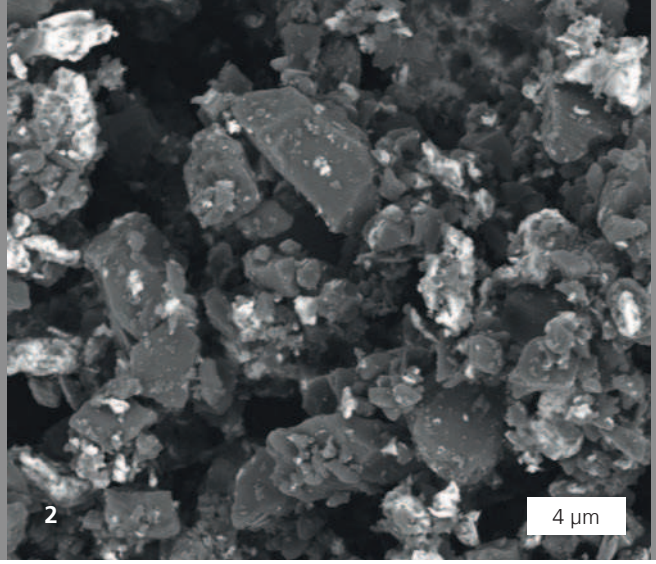

SMART FLUIDS – SWITCHABLE ABRASIVE SUSPENSIONS FOR FINISHING

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In many industries, abrasive machining methods are utilized for finishing (deburring, polishing, and rounding) of complex components. For example, in abrasive flow machining (AFM), a highly viscous polymeric carrier medium containing abrasive particles is alternately extruded through the top and bottom of the work piece, thus acting as a deformable "grindstone". In contrast, hydro erosive grinding (HEG) employs low-viscosity suspensions of fine abrasive particles and oil, which are pumped with high pressure through microscopic holes and round the edges due to erosion.

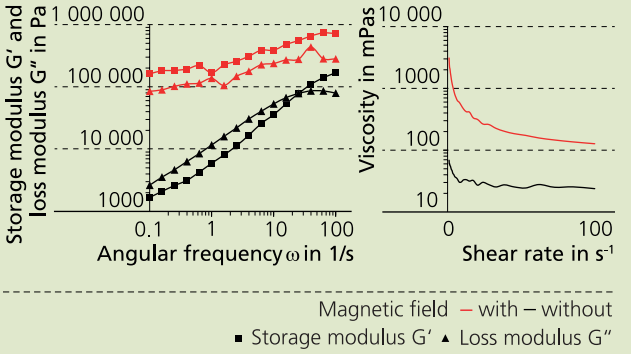
In both machining processes, high surface quality is achieved through removal of material with particle sizes in the micron range. However, up to now the processes have been non-directional, yielding dead zones or regions with undesired material removal.

In the BMBF project "SmartStream", both processes are being developed to enable specific local finishing by the use of magnetic fields and magnetorheological fluids (smart fluids), thus increasing process selectivity, performance, efficiency, and reproducibility.

In the design of the switchable low- and high-viscosity abrasive media, various characterization methods (rheology depending on the magnetic field, particle size, particle shape, and composition) that are also used for conventional abrasive suspensions are employed.

Two basic types of smart fluids are being developed (Figure 1). For type A, conventional abrasive media are mixed with iron particles, which align themselves along the field lines when a magnetic field is applied and thus increase the solidity or viscosity. In the case of type B, the abrasive particles themselves are magnetizable, and they hence move to the work piece when a magnetic field is applied and intensify the removal of material.

Increase in viscosity of an AFM paste (left) and an HEG oil (right) due to the application of a magnetic field



Due to the switchable strong increase in solidity (see diagram), a significant and specific increase of material removal efficiency is expected in both machining processes.

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1 *Schematic illustrating the working principle for smart fluids of type A and type B.*
2 *Magnetizable abrasive particles.*

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