

Less is more in new abrasive bond

Grinding wheels remove metal 20% faster and last 30% longer

Cutting tool and machine tool technologies tend to leapfrog each other, with one gaining a technological lead before the other catches up and moves ahead. In the field of grinding, the consumable has taken precedence with the launch in May 2013 of Saint-Gobain Abrasives' new bond, Norton Vitrium³.

It is incorporated into the company's latest, high performance, vitrified grinding wheels, which are able to exploit the full capabilities of grinding machines on the market, from top-end models to those of lower power and rigidity. The task of the bond matrix is to hold in place the abrasive grains, which can be of various types from the proprietary Norton Quantum ceramic to conventional aluminium oxide.

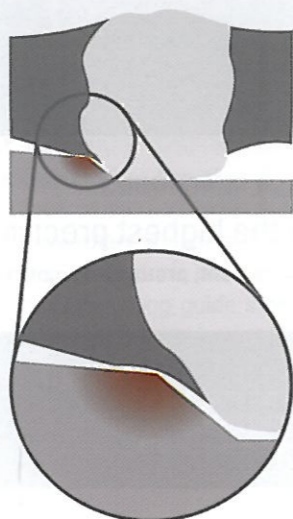
The last thing one wants in a grinding wheel is the bond material, despite it being essential to the wheel's stability. The other two constituents, abrasive and pores, are useful for removing metal from a workpiece and allowing coolant through. The bond, however, only gets in the way of a grinding wheel's functionality. The secret is to ensure that what are essentially particles of vitrified clay, or glass, impact the grinding process as little as possible.

Saint-Gobain Abrasives' R&D Division spent three years developing and optimising the Vitrium³ bond, applying for patents and bringing it to market. As a world-leading glass manufacturer, the company's parent group has considerable technological experience in vitrification technology, which was key to discovering the novel chemistry behind the formulation of the bond.

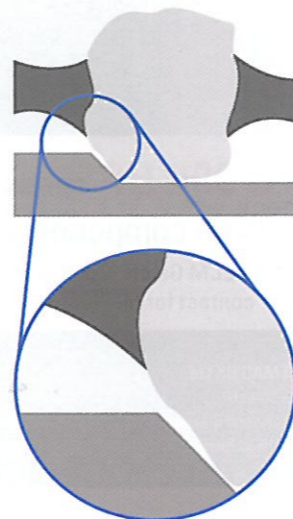
While extremely porous, Vitrium³ is the company's toughest bond to date, adhering strongly to the grains. It allows the grinding wheels to be light and hence used safely at speeds up to 80 m/sec, even though there is only a small amount of bond material retaining the abrasive. Higher feed rates, spindle speeds and infeed may be employed, significantly increasing productivity.

In addition to raising machining efficiency, the strong bond increases the life of Vitrium³

STANDARD BOND
BOND-PART INTERACTION



VITRIUM³ BOND
BOND-PART INTERACTION



wheels by up to 30 percent compared with conventional bonds.

Despite the low bond-to-abrasive ratio, grain adhesion and holding power are superior to those of any other bond. Wheel form retention and radius accuracy are significantly improved, reducing dressing time and so minimising wear on the diamond dresser and wheel, increasing the service life of both.

The grinding wheel structure increases exposure of the abrasive grains and improves coolant flow. The wheel is therefore able to discharge

swarf more efficiently and grind at a higher metal removal rate. Q' is typically 20 percent higher than when using wheels made with a conventional bond.

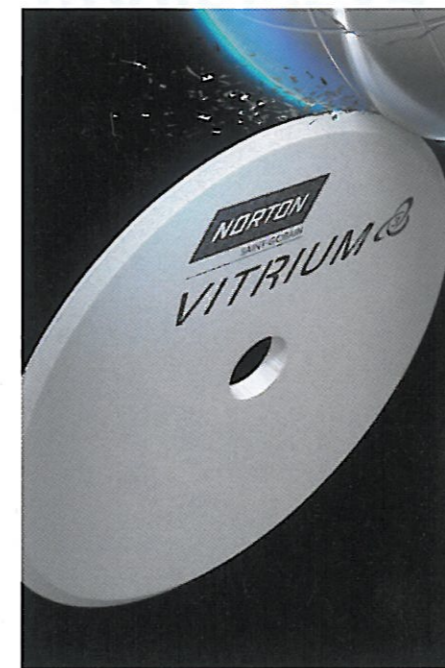
Greater exposure of the grain to the component being machined reduces grinding forces by up to 25 percent. The power drawn from a machine is lowered by typically 15 percent, saving energy, and workpiece deflection is reduced, leading to better machining accuracy. These characteristics also permit less rigid and lower

power grinding machines to deliver better results.

Grinding pressures and energy consumption are further reduced by decreased interaction between the bond and the component, a consequence of thinner bond posts holding the abrasive grains. An additional advantage is that free flow of coolant through the porous matrix results in efficient chip clearance, avoiding wheel loading and clogging. Grinding burn is practically eliminated, and so too are residual stresses and metallurgical change in the surface of the component.

This is especially important in aerospace applications, such as when jet engine vanes and turbine blades are being ground from nickel-based superalloys. It is also critical for machining other heat sensitive materials such as tool steels and chromium molybdenum. Creep-feed as well as traditional grinding practices are supported.

The versatile wheels are ideal for use across a wide range of industries. Applications include cylindrical grinding of automotive crankshafts and camshafts;



gear grinding; surface grinding of linear bearings and mould tools; internal grinding of hydraulic components, bearing tracks and gear bores; and centreless grinding of bearing race ODs (outside diameters), bar and tube.

It is worthwhile bearing in mind that the advantages of Vitrium³ hold true irrespective of the grain and wheel type, be it straight, cylindrical, cup or segmented. Each abrasive has distinct hardness, strength, fracture toughness and impact resistance properties, suitable for different applications. In some of Saint-Gobain Abrasives' more highly engineered grinding wheels, two or more grain types are often combined to achieve specific operational characteristics.

Interestingly, even the air in the Vitrium³ bond is highly engineered, benefitting the environment. When manufacturing the open structure, no pore-inducing chemicals are added to achieve the high level of permeability, unlike with other porous vitrified wheel technologies. Moreover, Vitrium³ is manufactured using a low firing temperature, reducing energy consumption and the bond's carbon footprint. The manufacturing method also eliminates costly process revalidation that is necessary when certain chemicals are included in a grinding wheel mix.

David Balshaw, business development manager - Engineered Markets at Saint-Gobain Abrasives, advises: "Whether the goal is to reduce total cost per part, increase throughput, or improve workpiece quality, Norton Vitrium3 is reshaping the

CASE STUDY LARGE TAPERED RING

Wheel with Vitrium³ bond:
Size: 200x200x93
Shape: Shape 01
Grain: Norton Quantum
Specification: 3NQP70G10VS3P
Competitor wheel:
Specification: xx80H6Vxx
Part:
Material: Steel 60 HRc
Part diameter: 432mm, width 180mm
Cycle:
Over thickness: 1.5mm
Wheel speed: 50m/s

RESULTS

Feed rate increased by: **+30%**
Cycle time reduced by: **-20%**
Total cost per part reduced by: **-15%**

CASE STUDY CENTRELESS PLUNGE GRINDING, SHAFT

Machine: Cincinnati Viking
Wheel with Vitrium³ bond:
Size: 406x75x203.2
Shape: Shape 01
Grain: Norton Quantum
Specification: 5NQP80NVS3
Wheel with standard bond:
Grain: Norton Quantum
Specification: 5NQP80NVQN
Part:
Material: Mild steel 35HRc
Rough cycle 1:
Infeed: 20mm/min Removal: 0.12mm
Rough cycle 2:
Infeed: 12mm/min Removal: 0.25mm
Finish cycle:
Infeed: 5mm/min Removal: 0.15mm

RESULTS

Infeed increased by: **+50%**
Cycle time reduced by: **-15%**
Total cost per part reduced by: **-15%**

world of precision grinding to meet these needs.

"We offer an exclusive Process Solutions Programme (PSP), free to customers, during which a trained engineer visits the user's site to analyse their grinding operations and make enhancements to increase productivity, improve quality, reduce costs and improve safety.

"With the introduction of the Vitrium³

CASE STUDY GEAR GRINDING - WORM

Machine: Kapp KX300P
Wheel with Vitrium³ bond:
Size: 320x125x115 63m/s
Shape: Shape 01
Grain: Norton Quantum
Specification: NQ80HVS3
Wheel with standard bond:
Grain: Norton Quantum
Specification: NQ80HVQN
Part:
Material: Steel 58-62HRc
Diameter: 210mm, width 25mm
86 tooth, module 2.5

RESULTS

Number of passes per cycle: **reduced from 3 to 2**
Parts between dress: **increased from 25 to 45**
Cycle time reduced by: **-16%**

CASE STUDY GEAR GRINDING - PROFILE

Machine: Gleason-Pfauter P1200G
Wheel with Vitrium³ bond:
Size: 400x45x127 32m/s
Shape: Shape 01
Grain: Norton TG
Specification: 3TGP60G10VS3P
Wheel with standard bond:
Grain: Norton TG
Specification: 3TGP60G10VXP
Part:
Material: Steel 60HRc
Diameter: 200mm, width 450mm
50 tooth, module 4

RESULTS

Dress compensation per part: **-40%**
Cycle time reduced by: **-13%**

bond, it is highly likely that our new grinding wheels will feature prominently in future optimisation programmes to reduce customers' unit manufacturing costs."

Further information on Norton Vitrium³ grinding wheels and PSP audits is available from David Balshaw, Saint-Gobain Abrasives. Tel: 01785 279553 or email: david.balshaw@saint-gobain.com or visit www.saint-gobain-abrasives.com