Dynamic Material Testing

GrindoSonic
THE IMPULSE EXCITATION TECHNIQUE

GrindoSonic® MK7 for Grinding Products

New options for Non-destructive Quality Control and Process Optimisation

The GrindoSonic® MK7 enables you to map the full mechanico-elastic fingerprint of your grinding products and ensures consistent quality when it comes to

Composition and Hardness
Porosity
Crack detection
Process optimization

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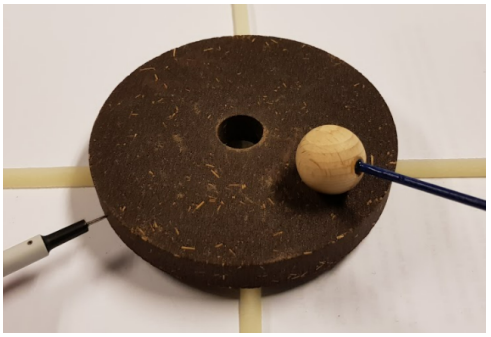
Introduction and Principle



GrindoSonic MK7 is based on the **pulse excitation principle**, where the main course of action consists of 2 steps: **"tap" and "read".** Consequently, the system will reveal the "mechanico-elastic" behaviour, say the **fingerprint** of your grinding product. This can be performed manually with the GrindoSonic MK7 instrument, semi-automatic with the SA System or fully automated in-line with the GrindoSonic IL system.

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Our Value Proposition

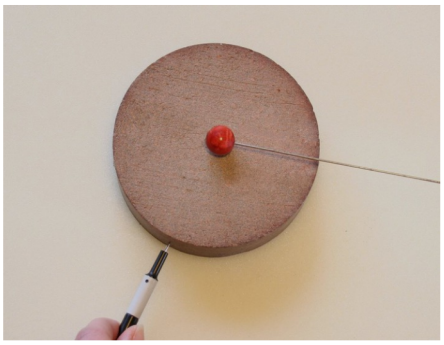
The production processes used in making grinding wheels can differ substantially with respect to composition and procedures depending on the manufacturer. Grinding wheels of identical nomenclature can still show differences in tool behavior in an actual grinding process.

The abrasive grain, bond and pore will ultimately determine the hardness, grain holding power and porosity of your grinding products. All these parameters have an effect on the mechanico-elastic fingerprint of your grinding product.

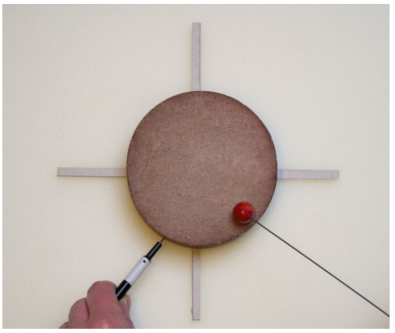
Manufacturers of grinding products have been trying to objectively guarantee the quality by destructive test methods, such as ZeissMackensen (sand blasting method) or Rockwell/Vickers/Brinell (indentation hardness test). These methods are generally usable for conventional grinding materials and fail to be useful for resin-based, CBN- or diamond based grinding materials.

The composition and hardness

With the GrindoSonic MK7 system, an easy “tap and read” procedure, you will be measuring the bending resonance frequency and simultaneously translate this data to the E-modulus of your product.



Flexural mode



Torsional mode

The signal is being analysed and the fundamental harmonic (first order Flexural or bending mode frequency) displayed on the front screen. From this frequency the Young's modulus (E-Modulus) is automatically calculated.
Also required for the calculation are weight and dimensions of the grinding product, simplified: **E = f² x m x D**
(E = Young's modulus, f = Fundamental frequency, m = weight, D = shape factor)

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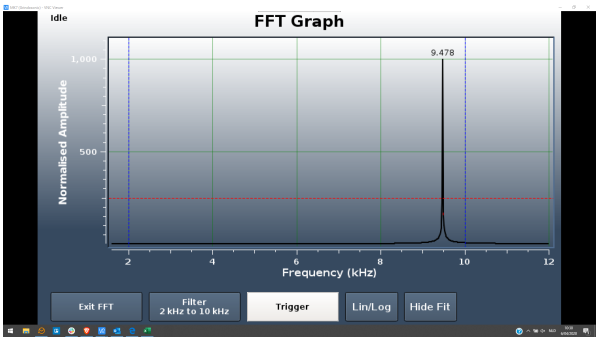
Although the E-modulus cannot be a direct measure to evaluate the grinding performance at work, it was concluded that this non-destructive method of the grade determination would be serviceable for resinoid grinding wheels.

Porosity

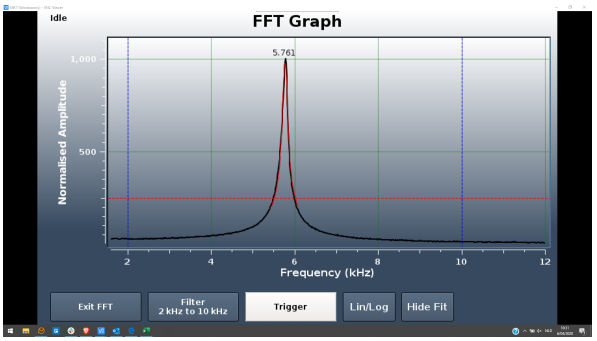
Porosity is definitely one of the most important properties of a grinding wheel in order to positively influence the performance. On the one hand, the pores support the supply of coolants into the grinding zone, and on the other they facilitate the removal of chips and residues. Additionally, due to the thinner bond bridges in porous systems, the interaction between bond and workpiece is significantly reduced, resulting in a lower thermal degradation or damage
The porosity of an object has a direct impact on the E-modulus of the object. A change in the porosity will be easily detected as porosity equals E(measured)/E(0).

Detection of micro-cracks

Very experienced operators will tell you if cracks are present in a grinding product by tapping on the part and “hearing” the tone. The GrindoSonic MK7 system will enable you to detect cracks easily using a scientific and repeatable method.
When cracks are present in a material, they act as centres where higher-frequency vibrations are absorbed. With the GrindoSonic MK7 system, the bending and torsional resonant frequencies on the grinding product can be measured together with their individual damping values. The damping values are directly related to the presence of cracks and will allow you to distinguish the cracked from the intact products.



low damping (12 Hz)
micro-crack free part



high damping (220 Hz)
highly micro-cracked part

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Maintaining consistent quality

It can be quite difficult to achieve consistent quality due to raw material scatter and non-uniformity of screening, mixing, pressing, firing and finishing.

The variation in the frequencies of resonance peaks is a function of the consistency not only of the hardness of the grinding product but also of its porosity and of the firing process. Any change in the firing process for example, can show up as either a shift in the average resonance frequency or as an increase in the variation of the individual peak frequencies.

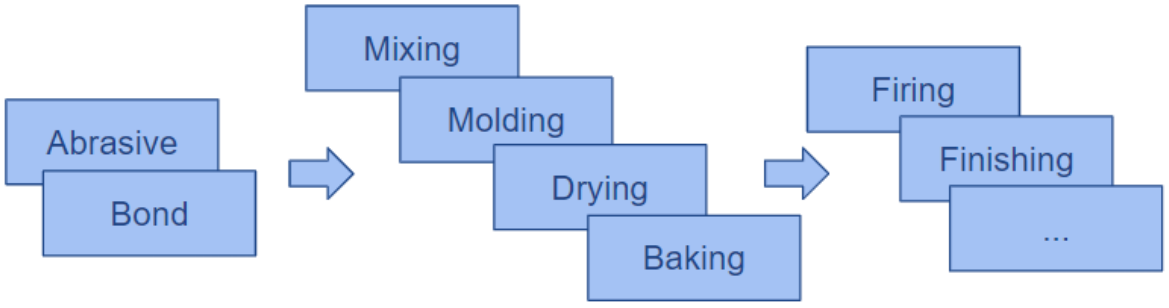
The GrindoSonic MK7 system measures the “signature” of a grinding product which can be checked against a reference signature. Grinding products appearing within the user defined tolerance band (frequency and damping) will be accepted or else rejected.

This overall Quality comprises parameters such as Elasticity (E-modulus), porosity, surface hardness, dimensions, presence of micro-cracks etc.

In this context, it might be advantageous for an end-user if grinding wheels have a similar grinding ratio (GR = Vw/Vg) and need for dressing. Again, the GrindoSonic MK7, unlike the previous systems, can detect up to 4 frequencies, it will give you a more accurate fingerprint of your grinding products and reveal inconsistencies causing (1) grain fracture, (2) attritious wear, and (3) bond fracture.

Process optimization

As explained in this note, with the GrindoSonic MK7 system the “mechanico-elastic” behaviour - the ***fingerprint*** of your grinding product - can be measured at the end of the production line.
When tuning a single parameter in the production process, its impact can be measured on the output of the line: a change in mechanico-elastic behaviour is ***one-to-one*** related to the modified parameter. As such that particular parameter, influencing the Elasticity of the grinding product, can be tuned so that the Elasticity is optimised.



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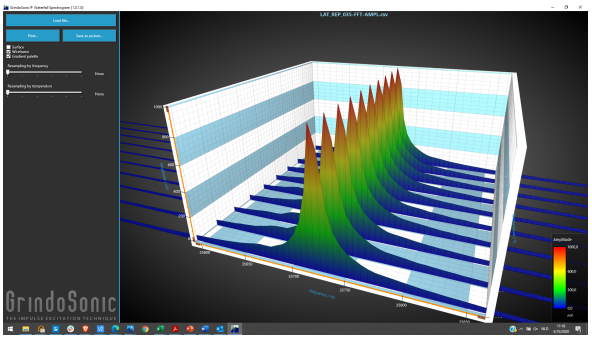
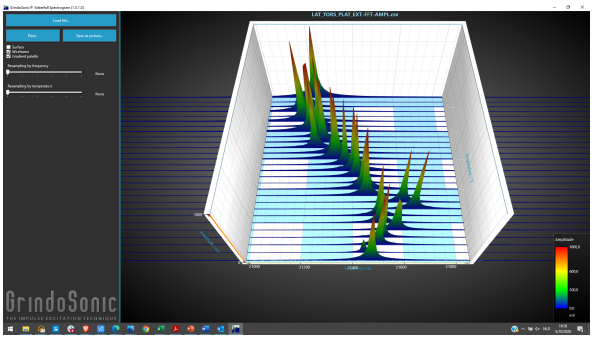
Similar to the mechanico-elastic behaviour, the same approach can be applied for the porosity, surface hardness, dimensions, presence of microcracks etc.

As an example, the spread (+/-3 sigma) on the produced grinding parts can easily be measured over a representative number of parts and can be gradually narrowed down by tuning multiple parameters, one at a time. With this approach the production process can be optimised and stabilised using an accurate, reliable, hands-on and non-destructive “tap and reed” procedure.



perfect stable production



unstable production

In addition to this the shift in resonance frequency by a certain process step can be evaluated by measuring pre- and post this process step. As such the stability of this individual process step can be measured and eventually tuned to obtain a better stability. Unstable process steps can be identified to improve the overall process stability and thus Quality.

The method and GrindoSonic MK7 have been described by various standards. Universities and institutes have developed objective formulas with GrindoSonic MK7 to calculate Young's modulus for bars, cylinders, tubes, discs and grinding products

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Over 1500 GrindoSonic® systems have been installed worldwide

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