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Improving surface roughness measurement by WA 3D technology

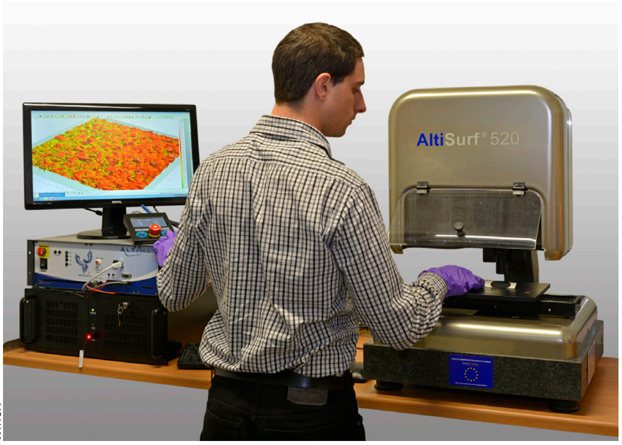
A key parameter for surface preparation before coating, the roughness of a steel or metal substrate impacts the interaction between paint consumption and the mechanical and corrosion-resistance properties of the coatings.

To measure roughness accurately in three-dimensions, W Abrasives has recently introduced WA 3D technology, which scans a replica of a blasted surface.

The replica is produced by applying replicating media – a polymer and curing agent automatically mixed in a disposable static-mixing nozzle – from a hand-held dispensing gun by a W Abrasives application expert. After about four minutes at room temperature, the resin created is removed with an accurate impression of the surface to which it was applied.

Each replica is taken to Winoa's R&D centre for analysis, where an optical profiling instrument, an AltiSurf 520 together with Altimap software, is used to measure 2D and 3D surface roughness parameters according to customer need. Quality analysis professionals still need both 3D and 2D parameters for reasons that include the use of 2D data in technical standards and historical part data.

The analytical equipment at the centre uses 'confocal chromatic imaging', in which a white light pinhole is imaged through a chromatic objective lens into a continuum of monochromatic images, whose wavelength depends precisely on the distance from the lens. One unique wavelength is perfectly focused at any given point on the surface of a replica placed in the light, enabling that specific wavelength to be reflected and detected by a spectrograph as an exact measurement of position, and hence surface height at that point.



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WA 3D technology scans a replica of a blasted surface with an Altimet system to obtain accurate surface roughness measurements

An area scan of the replica surface enables a 3D digital profile to be captured and analysed. Depending on the number of replicas to be scanned and the depth of analysis required, a report is available within 24 hours to a week from the time they are received at the centre.

The volume of paint needed to fill the roughness on an abrasive-blasted surface is traditionally calculated by extrapolating roughness measured in a straight line by a stylus in a profilometer placed in contact with the surface, which moves up and down over the surface contours. Unlike WA 3D, the conventional technique cannot scan complex geometries such as threaded parts.

The distance (in micrometres) between the highest peak and the lowest trough on a surface represents the 'dead volume thickness' that a coating has to penetrate just to cover substrate roughness. An additional dry film thickness – comprising nothing but coating – is needed on top of that according to the product being made.

There are two main drawbacks in relying purely on conventional linear data: roughness levels may vary across the width of a sample area (so parallel lines of measurement by stylus may yield different results); levels of roughness may vary in different directions (i.e. according to orientation), depending on the type of surface preparation undertaken on each part and the nature of the substrate.

Unlike shot blasting, grinding and polishing tend to create a directional surface roughness, for example. The shape, size and hardness of the blasting media affect the level of roughness achieved for a given application. Mass flow rate, velocity and angle of blasting are among other factors influencing the outcome.

A 3D scan allows a more accurate calculation to be made by measuring functional volume parameters, including void volume. For a specific metallic surface prepared for coating by abrasive blast cleaning, 2D and 3D analysis can result in substantially different results – in some instances resulting in a dead volume of only half the amount deduced from the older technique, and hence a significantly lower paint requirement.

The 3D data obtained are also valuable in analysing other important parameters such as lubrication volume, debris volume and contact area, which are relevant in the automotive, aerospace, medical, transport and energy sectors. The pipeline, shipyard, construction and rebar sectors are others for which steel and metal surface roughness is important.

Qualitative as well as quantitative evaluation helps to identify sizes, shapes and volumes of surface features. Both are crucial where technical specifications demand characterisation of surface texture.

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