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April 2005

Surface Texture Analysis of Ceramic Tiles Treated with Anti-Slip

Report Ref: **CPT 220305**
Date: 4th April 2005
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Title: Surface texture analysis of a ceramic tile treated with “Anti-slip coating”

Method:

The tiles measured were supplied by Karl Ward, 1 was treated with anti-slip coating, the other was left untreated, the following report details the method of analysis and results.

The nature of the tiles surface prevented direct measurement of the surface topography through optical means. Replicas of the surface were taken using Microset™ silicone rubber replicate.

Surface topography measurements were carried out on the Wyko NT optical interferometer using Vertical Scanning mode (VSI). Measurements were also conducted using the SOMICRONIC SURFASCAN stylus profilometer, this enabled a larger area to be measured, and also allowed measurement through fluid.

Surfstand analysis software package was used to invert the replicate measurements to give an accurate depiction of the tile surface, it was also used to analyse the measurements taken by the SURFASCAN.

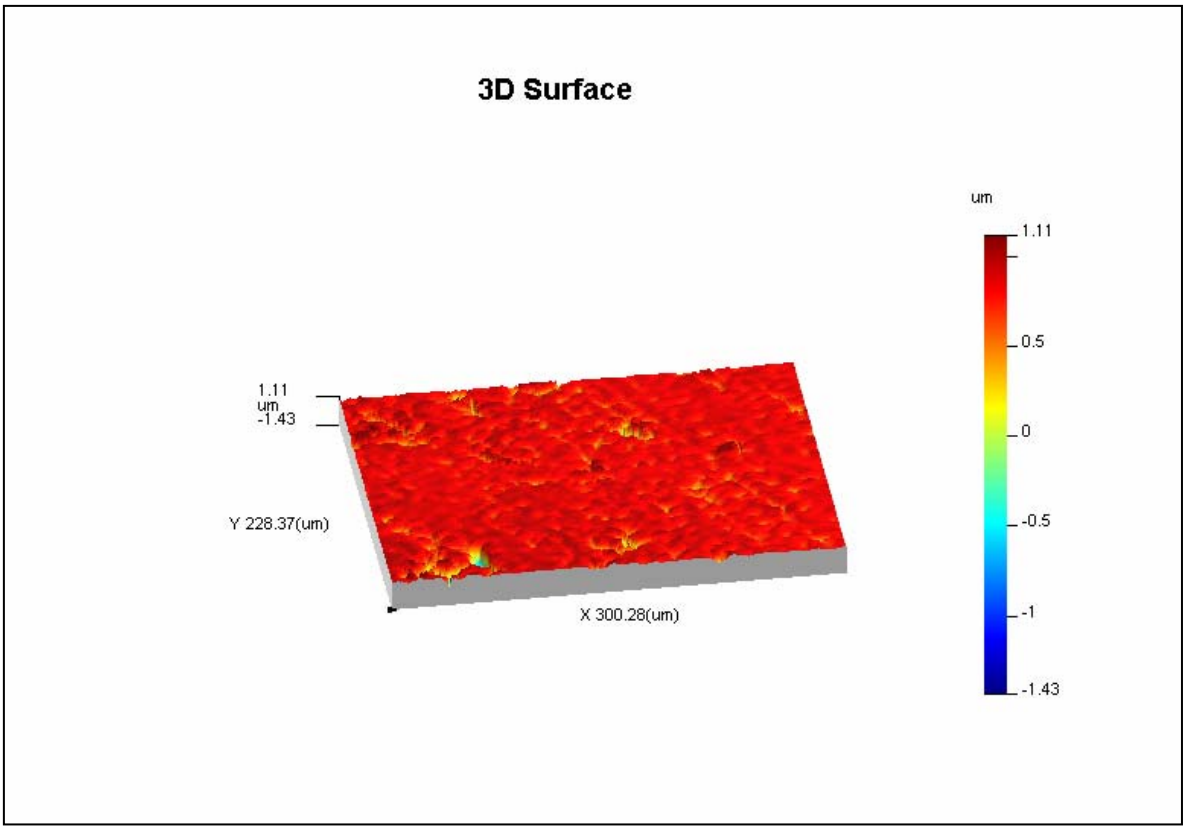
4 measurements were taken for each of the three states using the Wyko NT 2000 optical interferometer to gain an average for parametric analysis.

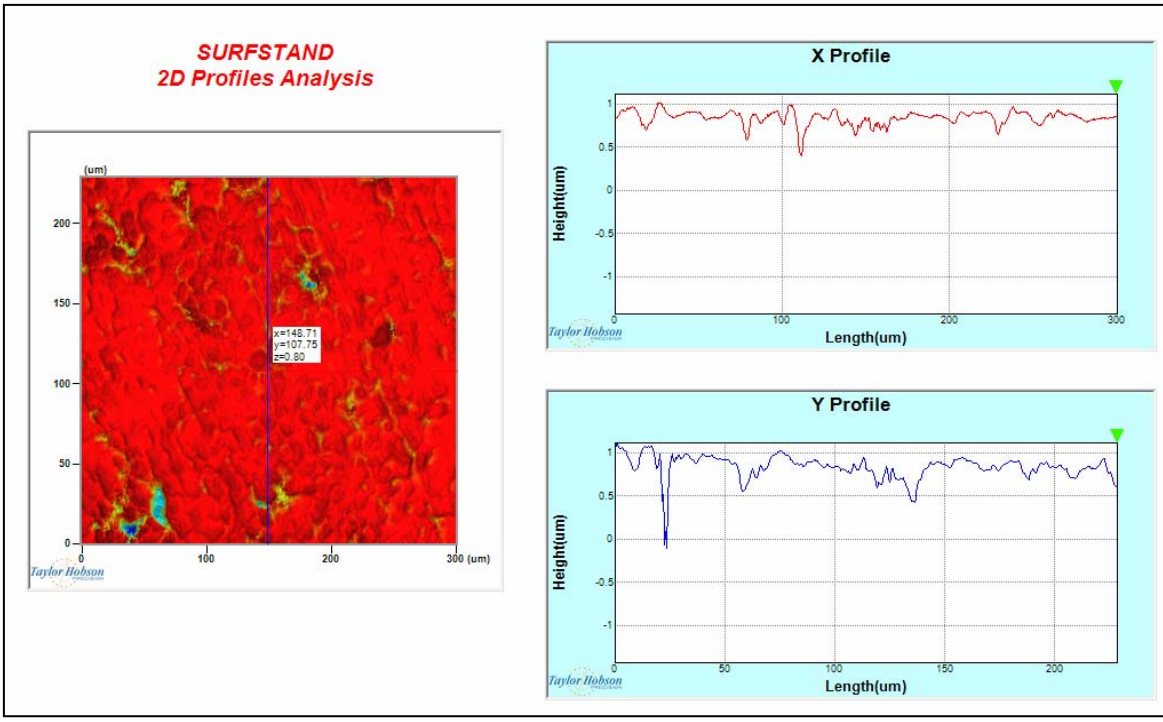
The measurement protocol:

Instrument	WYKO NT2000
Mode	VSI
Magnification	20 x
Measurement Area	0.3mm x 0.3mm approximate

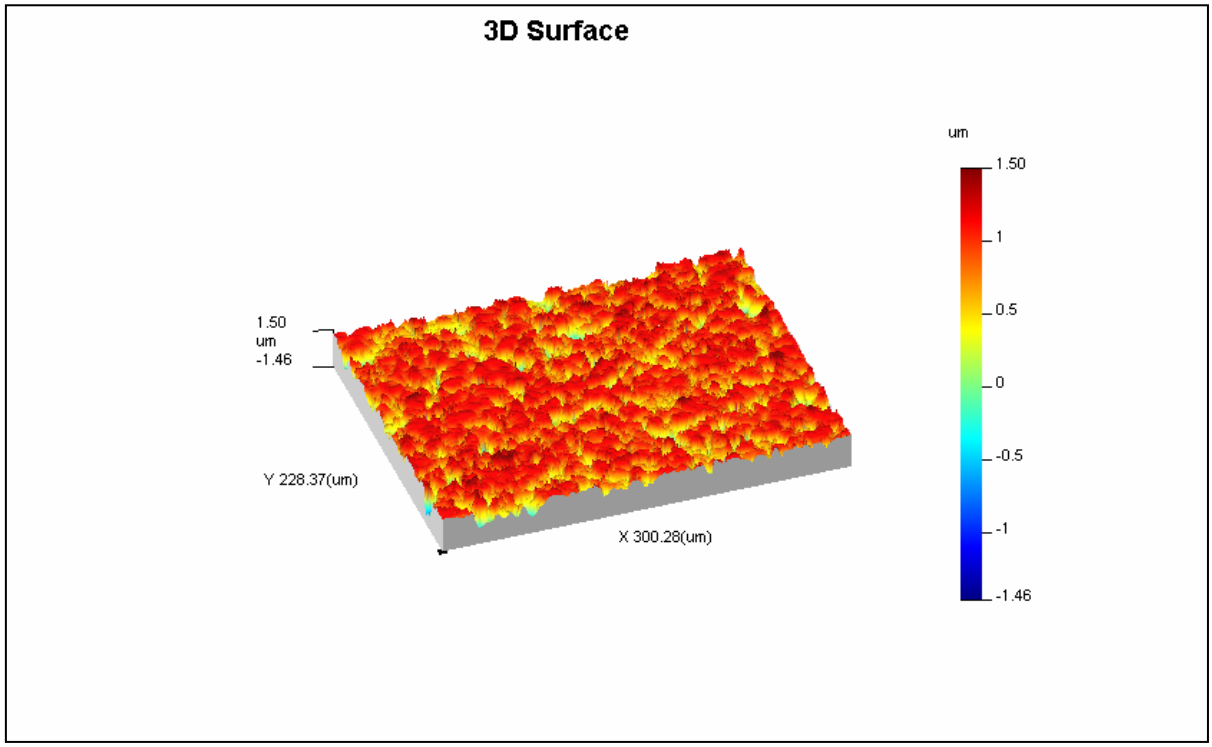
Instrument	SOMICRONIC SURFASCAN
Mode	Contacting Stylus
Measurement Area	3mm x 3mm

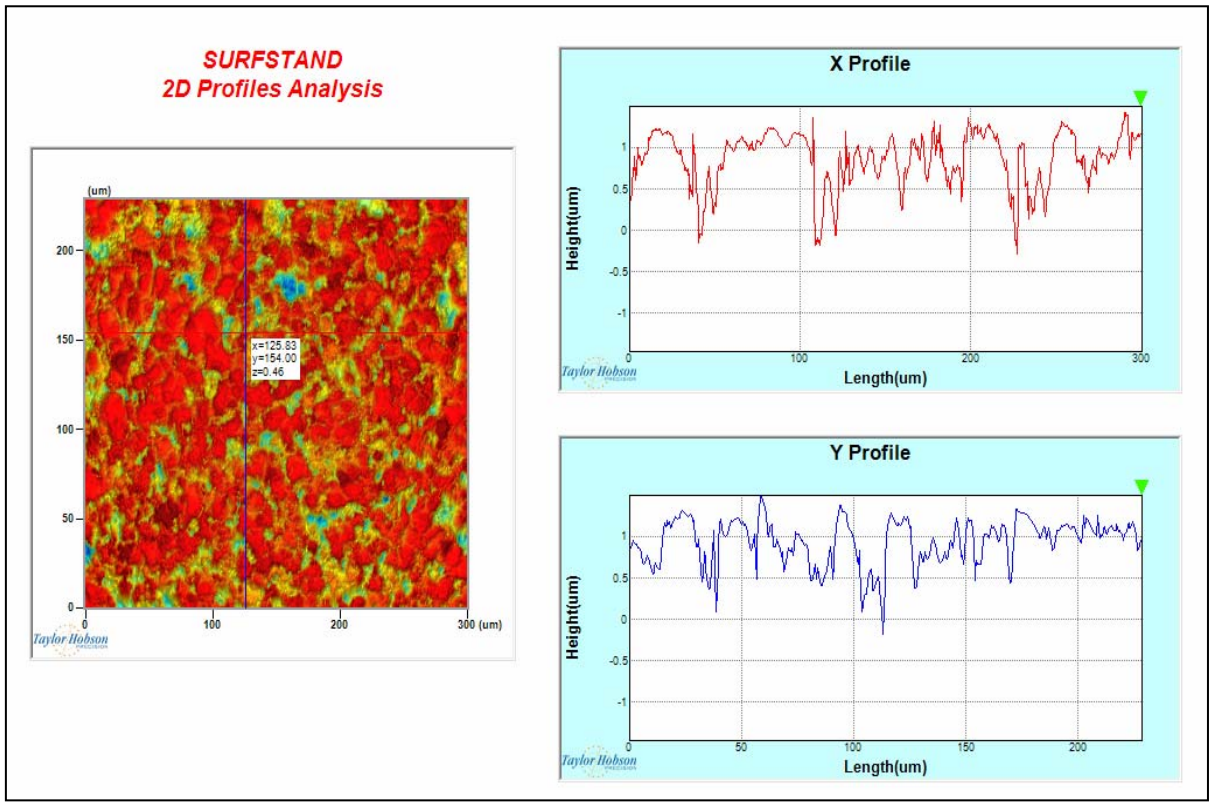
Dry Untreated Surface Topography.



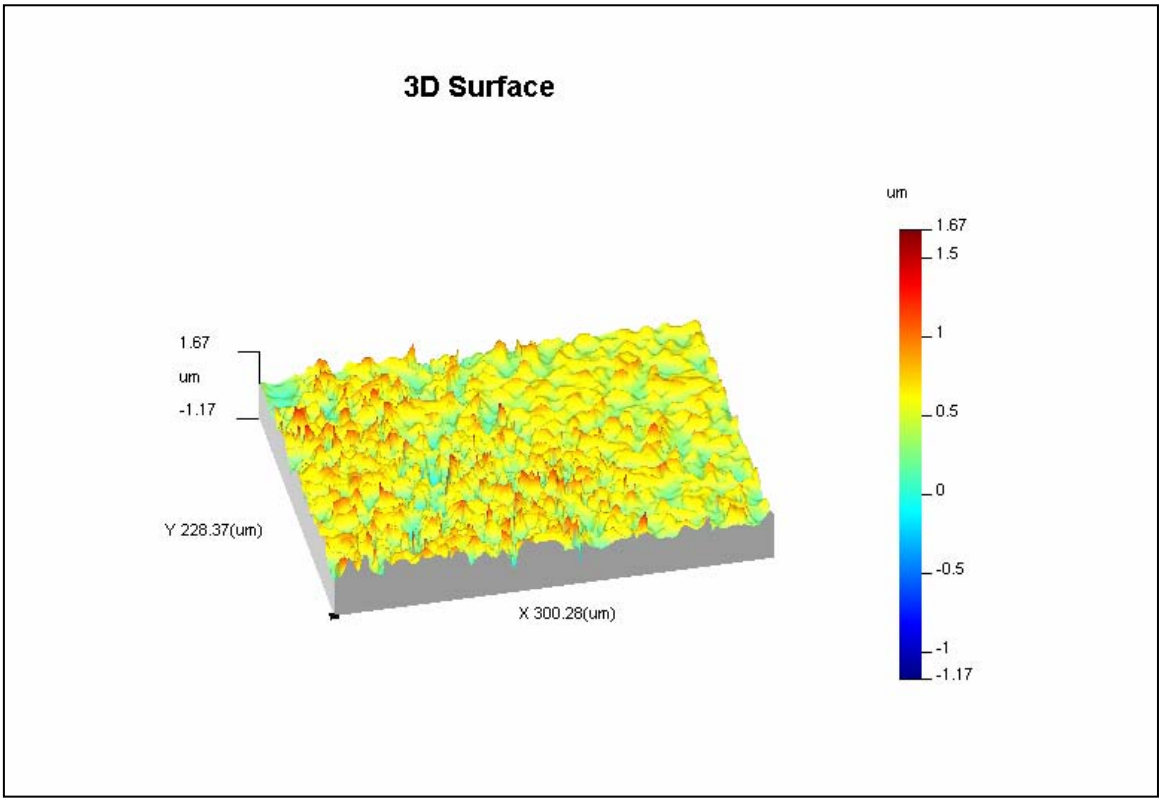


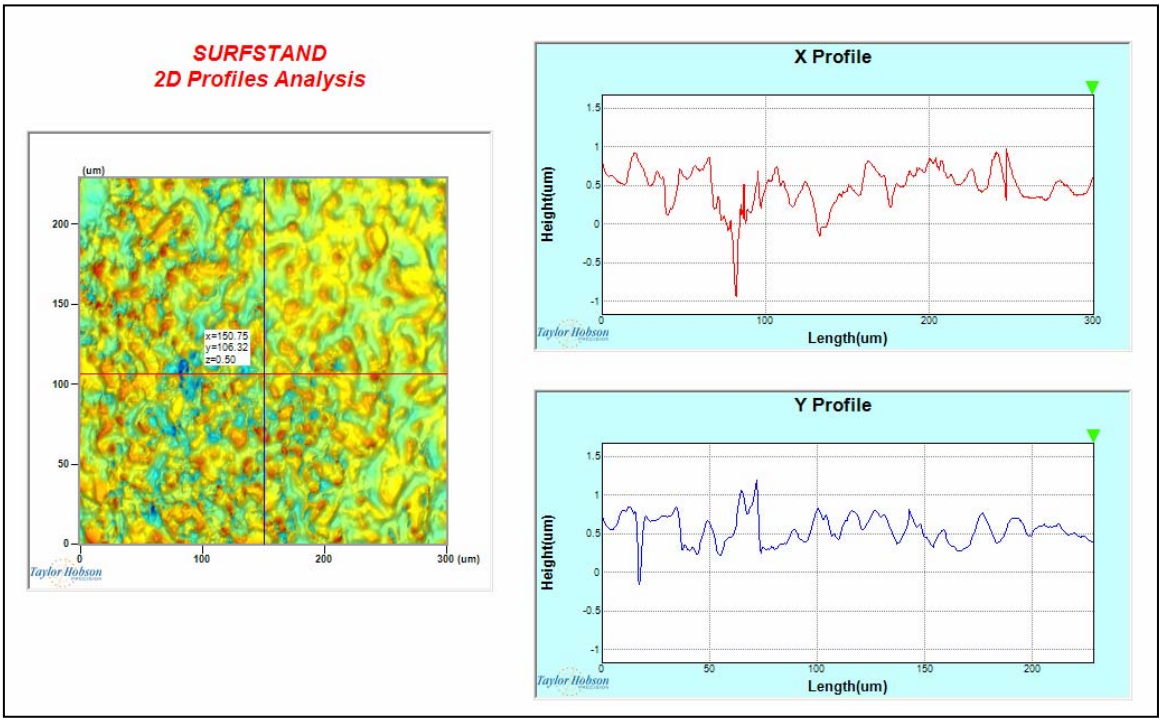
Dry Treated Surface Topography





Wet Treated Surface Topography



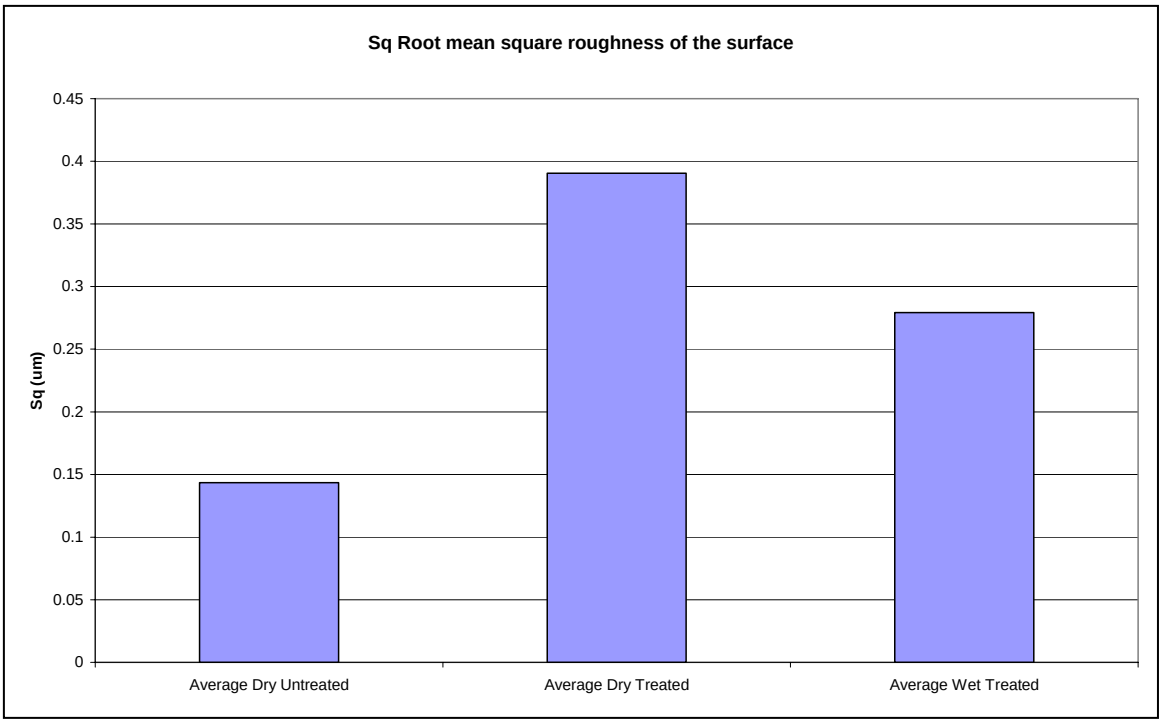


Parametric Analysis

3D surface roughness parameters were calculated for each of the measurements taken. An average was calculated from four measurements for each of the three states mentioned in the protocol. The following charts depict the average values for those parameters which are appropriate in indicating the differences in surface topography in this instance.

Sq – Root mean square roughness of the surface

Sq (the root mean square roughness of the surface) is an indicator of the surface roughness or smoothness.
From the chart below, it can be seen that the application of the surface treatment causes an increase in surface roughness; this surface roughness is then decreased following application of fluid/water. This indicates that the application of fluid causes a change in the surface roughness.

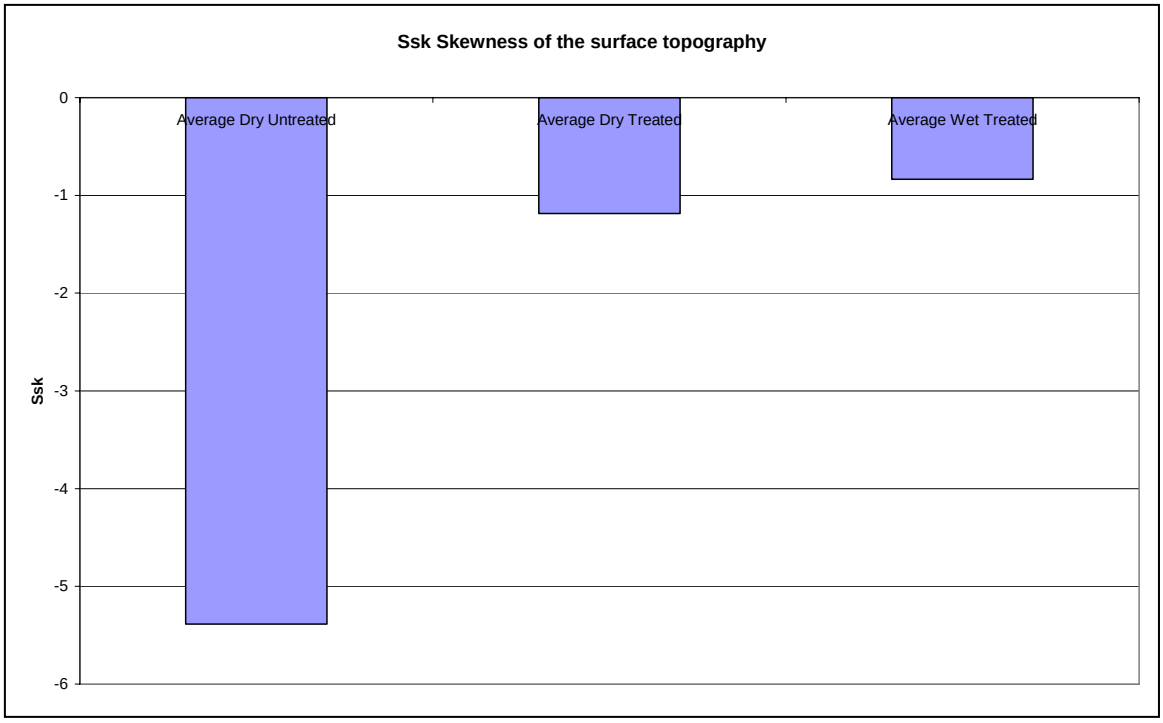


Ssk – Skewness of the surface topography

Although Sq indicates a change in the surface, it does not give information as to the nature of that change. The skewness parameter Ssk is a measure of the asymmetry of surface deviations about the mean plane. It can be a good indicator of the presence of peaks or pits of a surface.

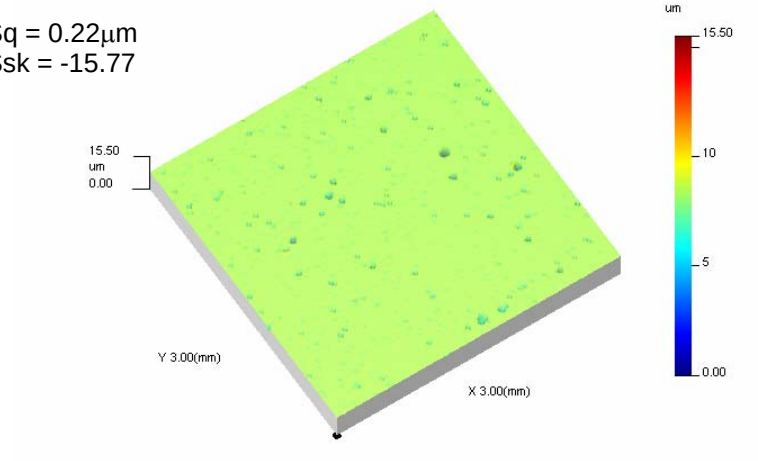
The chart below shows the Ssk values to be negative for all of the surface states, this indicates that the dominant feature (which is causing the surface roughness) is pits, rather than peaks on the surface.
The untreated surface, shows a lower value for Ssk, this indicates one of two things, either the prevalence of pits is higher, or that the pits are of a greater magnitude prior to surface treatment application.

Following application of fluid to the treated surface, the Ssk values tends back towards zero, indicating that the change in surface roughness depicted by Sq is due to decreasing prevalence of pits and increasing prevalence of peaks on the basic surface.



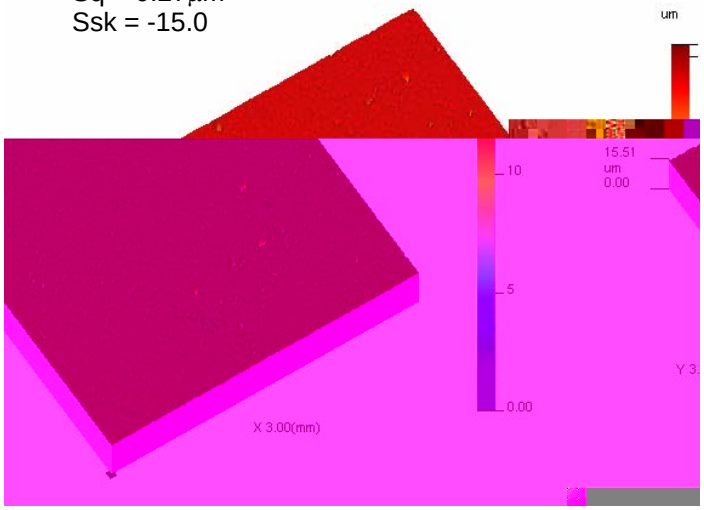
Measurements were also performed using a contacting stylus method, thus enabling measurement directly through fluid. The measurement area was 3mm by 3mm giving an insight into the overall effects on a larger area.
The following 3D axonometric plots of the surface topography are represented on the same scale.

Sq = 0.22µm
Ssk = -15.77



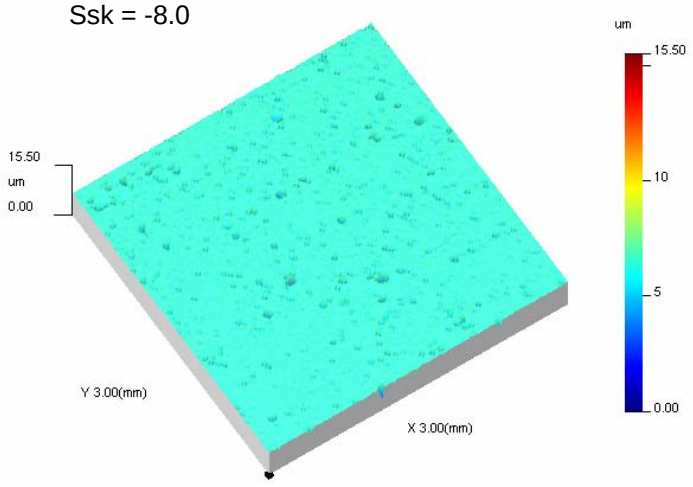
3D axonometric plot – Untreated Tile

Sq = 0.27µm
Ssk = -15.0



3D axonometric plot – Dry Treated Tile

Sq = 0.29µm
Ssk = -8.0



3D axonometric plot – Wet Treated Tile

Conclusions

Although the surface topography of the tile surface has higher root mean square roughness following treatment, there is no indication of large pits or valleys forming. It would appear that the treatment produces a general roughening, however the increase in roughness is considered not to be of a level easily registered by tactile feel, this is reinforced by the measurements completed over a large area using the contacting stylus method.

The surface treatment that is applied affects the surface in such away that the pits which are present on the surface following treatment are reduced in prevalence in some way when the surface becomes wet. It appears that this change in the surface could be linked to the evident increase in friction when the surface is wet.

The measurements performed at a high magnification on the optical interferometer show definite changes in the surface topography following application of the surface treatment and again after the application of fluid/water. The measurements on this micro level show a definite change in both the surface roughness and the way in which the surface is dominated by pits becomes less pronounced. The measurements performed with the contacting stylus over a larger area show little change in the surface roughness.

The surface treatment changes the surface, it does not appear to completely remove the glaze and etch the surface, however on a micro scale a roughening of the surface does occur. Following application of water to the treated surface, a temporary change occurs to the surface. From the visual surface topography maps and from the parameter analysis, it appears that the pitting caused by the initial treatment of the tile surface lessens. This could be due to one or both of the following. The pits become less prominent due to some change in their size or shape

This change in the surface topography could influence the frictional properties of the tile when water is present.