Nano-structured self-cleaning coated glasses: modelling and laboratory tests for fundamental knowledge on thin film coatings, EC normalisation and customer benefits

Final Report Summary - SELF-CLEANING GLASS (Nano-structured self-cleaning coated glasses: modelling and laboratory tests for fundamental knowledge on thin film coatings, EC normalisation ...)

Superhydrophobic or hydrophobic coatings have been used in the recent years for several applications, such as easy-to-clean surfaces. Since 2001, hydrophilic and photocatalytic self-cleaning glazing have been available in the European market. These latter products were based on the photocatalytic property of a thin layer of TiO2 deposited at the surface of the glass. When exposed to UVA radiation, TiO2 reacts with the oxygen and water molecules present in the atmosphere to produce free radicals leading to oxidative species. These species are able to degrade organic material causing stains adsorbed on the surface into volatile molecules. Both technologies cover products designated by the general term of ‘self-
In order to define appropriate tests for the self-cleaning properties of nano-structured surfaces, the project was based on two main objectives. Firstly, it was necessary to acquire a thorough understanding of the real soiling mechanisms of commercial self-cleaning glasses compared to standard float glass. So, the first part would consist of field tests at well-monitored sites. Extensive experimental studies were planned in different polluted atmospheres. Secondly, the definition of standard test methods for the self-cleaning properties, highlighting the benefits for customers would be developed. This second part would consist of the setting-up of the parameters based on:

- Laboratory tests relevant for the characterization of the surface properties of self-cleaning glasses.
- Laboratory tests representative of the behaviour of self-cleaning glasses compared to standard float glass in a real atmospheric environment and based on the results of the first part.

The scientific and technical objectives of the project were the following:

- To provide scientific knowledge on behaviour of standard and self-cleaning glass in urban polluted atmosphere.
- To provide fundamental knowledge on mechanisms and modelling of self-cleaning glass functionality.
- To provide soiling methods measurements, elements and data, essential for the setting-up of a new standardisation for self-cleaning glass.
- To develop a European standard for self-cleaning glass.
- To avoid non-appropriate standardisation imposed on glass products coming from other substrate types or applications.
- To gain fundamental knowledge for future generation developments of self-cleaning products.

Samples of different type of glasses were exposed in Paris test site for soiling mechanism analysis. Preliminary results of WP1 were indicating some differences between photocatalytic self-cleaning glasses and reference glasses.

Samples of glasses were also exposed in the frame of WP2 in 4 different sites to study the impact of glass processing (annealed, tempered, laminated, silicone joints), and weathering conditions.

WP3 was looking at the chemical reactions at the nanoscale level through macroscopic systems synthesised in the laboratory for which factors governing the photocatalytic effect were taken into account. The influence of different experimental parameters on photocatalytic efficiency of the self-cleaning glass was investigated and identified (i.e. temperature, humidity) on self-cleaning properties.

WP4 developed a procedure for a visual quality ranking of product in relation with physical measurements such as haze measurement. The test method simulating real conditions was established: it was showing promising results allowing to discriminate self-cleaning glass from standard glass and it was further optimised. In parallel, a flow chart describing a strategy to standardisation was submitted in the frame of WP6.

The test procedure applied was the following: A soiling solution was sprayed on a self-cleaning glass and haze measurement was taken. After UV A illumination and water sprayed on the surface, another haze measurement was taken.
Haze measurement was taken. After UV-A illumination and water sprayed on the surface, another haze measurement was recorded. Then a second soiling cycle was carried out. When the percentage of cleaning was >85 %, the sample was said 'self-cleaning'.

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