May 2018

EXECUTIVE SUMMARY: *A review of the latest evidence of the effectiveness of photocatalytic materials and treatments in tackling local air pollution* by Environmental Industries Commission (EIC)

Introduction

Photocatalytic coatings and treatments based on TiO_2 nanomaterial have created wide interest and extensive studies over the years because of their potential to reduce a wide range of airborne pollutants (NOx, VOC and carbon particulates) in a convenient and non-intrusive manner.

In April 2016, the UK government issued a report through its Air Quality Expert Group, claiming there was little evidence that photocatalysis could reduce ambient concentrations of airborne NOx and that there were risks that undesirable species (typified as HONO – nitrous acid) could be formed during the photocatalysis reaction.

This is contrary to Cristal's own experiences based on several years of extensive laboratory and field trial work, and therefore in 2017 a fully independent, detailed analysis of published work on photocatalysis was initiated through the Environmental Industries Commission (EIC), an organisation representing UK businesses working to solve environmental problems.

EIC methodology

The Imperial College London was commissioned to undertake a thorough technical analysis of all available, published evidence of laboratory, semi-scale and full-scale field trials for photocatalytic concretes, asphalts, coatings and treatments. This analysis was comprehensive and covered approximately 100 published articles and 12 field trials. The final technical report comprises 35 pages of detailed analysis and commentary.

Imperial College also modelled a London street canyon scenario using experimentally determined published deposition velocities for NO and NO_2 on photocatalytic surfaces to estimate NO and NO_2 reductions in the street canyon under typical London conditions.

Temple Group, an established environmental consulting group, was asked by EIC to update a previous analysis issued in 2015 comparing the cost effectiveness of photocatalytic coatings and treatments with other technologies being used to reduce air pollution.

EIC findings

Modern TiO_2-based coatings and treatments can abate NOx present in air under natural external light conditions and photoactive TiO_2 products can be successfully incorporated into a wide range of building materials (concretes, asphalts, paints) to produce cost-effective depolluting surfaces.

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Wide ranges of photoactivity and anti-polluting performance are reported and some published works refer to the formation of intermediate species such as HONO, but it is noted that under normal exterior conditions on mineral substrates, such formation is unlikely to be significant.

Field trials have shown varying levels of success, those with inferior performance can be attributed to (i) low activity of the treatment used, (ii) the small area of treatment applied, and (iii) in particular for tunnel trials, the intensity of UV light used.

Modelling studies predicted a reduction in NOx levels between 15% and 38% in a London Street canyon, which is in line with the better performing field trials.

Cost efficiency studies calculated a net present value cost of GBP 40,500/tonne of NOx removed. This was compared and found to be highly competitive with other current options for NOx removal (e.g. electric car introduction, conversion to Euro 6c diesel car standards, etc.).

Conclusions

EIC found that the UK's current statement on photocatalysis was too pessimistic and recommends:

- The UK air quality strategy should now include further assessment on the role of photocatalytic treatments
- Funding should be made available for a number of controlled large scale trials in Low Emission Zones to further define the benefits in air quality
- The Air Quality Expert Group releases an update to its 2016 report acknowledging the additional findings of the Imperial College research
- Further work should be carried out to clarify the conditions for avoiding the formation of intermediate species such as HONO

Cristal has further experiences and proprietary data not available to EIC and therefore it is not considered in this document. Cristal's data supports, and is consistent with, the findings and conclusions outlined above.

Cristal firmly believes that the latest generation of photocatalytic TiO_2 products which are now available from its own CristalACTiV™ product range and from other titanium dioxide producers, allow formulators to produce high quality depolluting coatings and treatments which can significantly contribute to the reduction of urban air pollution levels if applied correctly and to sufficient surface areas.

While the EIC report was primarily focused on the UK and the UK Air Quality Expert Group's statement, the work is directly applicable and of interest to government bodies, administrators and influencers in other cities and heavily polluted areas around the world.

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