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Immobilized particle coating for optimum photon and TiO_2 utilization in scaled air treatment photo reactors

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ABSTRACT

This study reports the critical importance of the particle state in TiO_2 immobilized photocatalysis. To address this, TiO_2 coatings are prepared using two methods: an Air Assisted Spray with an Automatized Spinning Coating (TiO_2-AAS-ASC) and a Spread Coating (TiO_2-SCM). The state of the TiO_2 particles is investigated using SEM and local gravimetry. It is proven that the TiO_2-AAS-ASC displays homogeneity, limited particle agglomeration, close to optimum thickness and stability under flow. Furthermore, the prepared coatings are evaluated in terms of photoactivity using acetone in air mineralization in the 24–49 μmol/L initial concentration range. This allows Quantum Efficiency evaluations based on absorbed photons and hydroxyl radical consumed. It is proven that the TiO_2-AAS-ASC exhibits a close to expected optimum photoactivity and QYs in the 0.4–0.5 range. Furthermore, when the TiO_2-AAS-ASC is assessed in terms of QY per unit weight of photocatalyst (QY/W), it shows a value 3 times higher than the TiO_2-SCM. This high photon utilization is close to the best possible level expected for an optimized TiO_2 coating.