A dust reduction system based on corona discharge and electric wind

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During the last 30 years, the Aerosol Laboratory of the University of Technology Delft has performed research in the field of "the manipulation of aerosol particles by electrical forces". The different topics include Electro HydroDynamic Atomization (Electrospraying), influencing the trajectories of charged aerosol particles, the extraction of materials from plants by electrical fields (milking of trees) and the developing of instruments to measure charge on aerosol particles. Numerous papers have been published on these subjects, of which a few can be found in the references (Meesters e.a. 1992, Meesters 1992, Vercoulen e.a. 1992, Vercoulen 1995, Hartman e.a. 1999, Sanden van der 1999, Marijnissen e.a. 2001, Khoury 2006, Djairam 2008, Yurteri e.a. 2010)

In continuation of this work and with data from literature (Weinberg 1968, Johnston e.a. 1987, Uchiyama and Jyumonji 1995, Roos 1996), a dust reduction system has been developed, which working is based on electrical effects. The system employs corona wires and/or needles, to create ions and an electric wind. With an appropriate configuration of corona wires /needles and a particle collector, a very efficient aerosol particle collection system can be constructed. The first system was developed together with BAM Infratechniek bv, and partially financed by the Ministry of Transport, Public Works and Water Management of the Netherlands. A very extensive research project was undertaken in a real, in use tunnel of 1100m long in the Netherlands, the Thomassentunnel. Only a limited amount of dust collection racks was used, and yet the reduction in outlet dust concentration (by mass) was measured to be about 16 % in comparison with no dust reduction. Modelling at TU Delft indicates that by increasing the number of collection racks from 28 till 340, the outlet dust concentration reduction is enhanced till 70%. Measurements and modelling prove that all filtration mechanisms, including electric ones and turbulence in the tunnel play a role and that the collection takes place over the whole measured size range (report IPL 2009, Valbuena 2011).

In a next stage the dust reduction system has been modified to be utilized in heavy polluted industrial sites, in the exhaust of large-scale pigsties and poultry farms, outside street canyons and restricted outside areas. In all situations the system demonstrates a good efficiency in dust collection.

Recently the system has been adapted for indoor use, such as hospitals, offices, light industries and households. While the energy consumption is very low, the particle collection efficiency is very high.

In the presentation the scientific background of the dust collections system will be clarified and examples for the different applications will be provided, including particle collection efficiency as a function of particle size and the energy consumption.

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