Three-dimensional flow and turbulence structure in electrostatic precipitator
Stereo PIV is employed to study the three-dimensional velocity and turbulence fields in a laboratory model of a negative corona, barbed-wire, smooth-plate, electrostatic precipitator (figure 1). The study is focused on determining the parametric effects of axial development, mean current density $J_m$ and bulk velocity $U_0$ on secondary flows and turbulence levels and structures due to the action of the three-dimensional electrostatic field on the charged gas. At constant bulk velocity ($U_0 = 1$ m/s) and current density ($J_m = 0.4$ mA/m²), secondary flows in the form of rolls of axial vorticity with swirl numbers up to $S = 0.3-0.4$ are found to level off after 4-5 electrodes, being most regular in the central unit cells defined by the periodic geometry of pin-electrodes. The corresponding image-mean turbulence intensity increases to about 20% from the 1st to the 7th electrode with a consistent anisotropy of normal Reynolds stresses. The effects of $U_0$ and $J_m$ on $S$ and $T_u$ (at fixed position between 6th and 7th electrode) are reasonably correlated by the electrohydrodynamic modulus $NEHD = (J_m/bi)\ln((r/\sigma U_0))$, where $bi$ denotes the ion mobility and $ly$ the electrode-plate distance.

Modeling of a straw fired boiler

General information
Publication status: Published
Organisations: Department of Energy Engineering
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Publication date: 2000