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Efficiency of particle charging by an alternating electric field charger

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Abstract

Alternating electric field charger is a device in which the particles are charged by ionic current and periodically deflected by alternating electric field during their flow through the charger. The oscillatory motion of small amplitude reduces the particle loss within the charger. The results of measurements of mean charge of the particles at the outlet and their penetration through the charger are presented in the paper.

Keywords: AC field charger; Particle charging; Particle penetration; Aerosols

1. Introduction

Alternating electric field charger is a device used for dust particle or liquid droplet charging. In this type of charger, the particles are charged by ionic current generated by an electrical discharge and forced to oscillate by alternating electric field. In DC corona chargers with perpendicular electric field the particles are deflected and deposited on the charger electrodes. In the alternating electric field chargers, the alternating field prevents the particles from being precipitated, and the loss of the particles is reduced. Two types of chargers, the Masuda boxer charger [1,2], and

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Jaworek and Krupa alternating electric field charger [3,4] utilise this concept. In the Masuda charger, the ions are generated by high-frequency (16 kHz) surface discharge. The alternating electric field of low frequency (500 Hz), causing oscillatory motion of the particles to be charged, is generated with an additional pair of electrodes. In the alternating electric field charger, considered in this paper, the ions are provided by corona discharge from two electrodes located at opposite sides of a channel. The alternating electric field is generated by two additional grids placed between these discharge electrodes. The particles flow between the grids where they are charged. The process of particle charging in this type of charger was investigated in [5], and the current–voltage characteristics were presented in [6]. It was shown [6,9] that the amplitude of particle oscillation decreases with increasing frequency that is advantageous to low particle loss, but for frequencies higher than 300 Hz the ionic current decreases and the particle charge is reduced.

In this paper, the results of measurements of mean charge of the particles leaving the charger and the particle penetration through the charger are presented.

2. Experimental

A schematic diagram of the stand for investigating the alternating electric field charger is shown in Fig. 1. Experiments were carried out for the charger of grids made of stainless steel rods 2 mm in diameter spaced at 15 mm. Each grid was 130 mm high and 165 mm long. The distance between the grids C and D was 50 mm. The discharge electrodes, A and B, were composed of a set of stainless steel needles 5 mm long, spaced at 15 mm, which were soldered to a brass sheet. The charger was mounted in a channel of cross-section of 160 × 160 mm made of plexi glass. The edges of the channel are drawn with a dashed line in Fig. 1. The electrodes of

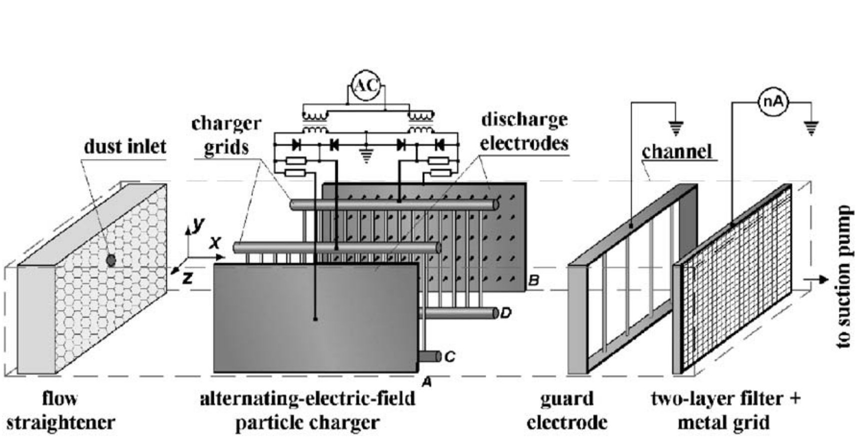

Fig. 1. Schematic diagram of the experimental stand with alternating electric field charger.