Improvement of the cyclone separation efficiency with a magnetic field

Moein Siadaty, Saeid Kheradmand, Fatemeh Ghadiri

www.elsevier.com/locate/jaerosci

PII: S0021-8502(17)30171-4
DOI: http://dx.doi.org/10.1016/j.jaerosci.2017.09.015
Reference: AS5190

To appear in: *Journal of Aerosol Science*

Received date: 10 May 2017
Revised date: 23 July 2017
Accepted date: 11 September 2017

Cite this article as: Moein Siadaty, Saeid Kheradmand and Fatemeh Ghadiri, Improvement of the cyclone separation efficiency with a magnetic field, *Journal of Aerosol Science,* http://dx.doi.org/10.1016/j.jaerosci.2017.09.015

Improvement of the cyclone separation efficiency with a magnetic field

Moein Siadaty[a1], Saeid Kheradmand[a], Fatemeh Ghadiri[a]

[a] Department of Mechanical and Aerospace Engineering, Malek-Ashtar University of Technology, Shahin-Shahr, Isfahan, Islamic Republic of Iran

Abstract

In this paper, an attempt is made to improve the gas-solid cyclone collection efficiency by applying a low strength magnetic field. At first, Eulerian-Lagrangian approach is utilized to model the fluid flow and track a large number of solid particles inside a high efficiency Stairmand cyclone with body diameter of 0.3 m. Then, response surface methodology (RSM) is used to design a series of experiments with magnetic number, horizontal and vertical distance of the magnetic field source from the origin as the effective parameters. Finally, desirability function is used to calculate the values of the effective parameters at which the efficiency has its highest value. Also, a comprehensive study on the effect of magnetic field parameters on separation efficiency is done by means of sensitivity analysis. The results show that a low strength magnetic field can increase the separation efficiency for 2 and 4 μm particles from 82.96% and 97.78% to 91.11% and 100%, respectively. Analysis of response surface methodology declare that there is a strong interaction between the magnetic number and the position of the magnetic source. Sensitivity analysis shows that separation efficiency is highly sensitive to the vertical distance of the magnetic source from the origin, rather than horizontal distance and magnetic number. Also, the total separation efficiency is increased by 1.1% at its optimum value. Increase in separation efficiency without a change in pressure drop and cyclone geometry configuration are the main advantages of this method.

Keywords:

Magnetic field, separation efficiency, cyclone separator, response surface methodology, CFD simulation

Nomenclature

[1]Corresponding Author. Tel: +989127316043
Email addresses: Moein.siadaty@gmail.com (M. Siadaty), saeid_kheradmand@yahoo.com (S. Kheradmand), fatemeh.ghadiri@gmail.com (F. Ghadiri)