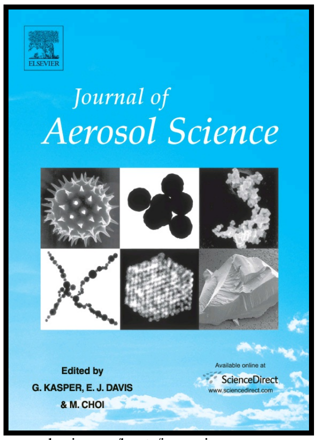
# Author's Accepted Manuscript




www.elsevier.com/locate/jaerosci

Diffusive Deposition of Aerosols in a Fibrous Filter

C.F. Clement, S.J. Dunnett

PII: S0021-8502(18)30158-7
DOI: https://doi.org/10.1016/j.jaerosci.2018.08.002
Reference: AS5322

To appear in: *Journal of Aerosol Science*

Received date: 24 April 2018
Revised date: 29 June 2018
Accepted date: 6 August 2018

Cite this article as: C.F. Clement and S.J. Dunnett, Diffusive Deposition of Aerosols in a Fibrous Filter, *Journal of Aerosol Science,* https://doi.org/10.1016/j.jaerosci.2018.08.002

# Diffusive Deposition of Aerosols in a Fibrous Filter

C. F. Clement[a], S. J. Dunnett[a,b]

[a]15 Witan Way, Wantage, Oxon OX12 9EU, UK

[b]Department of Aeronautical and Automotive Engineering, Loughborough University, Loughborough, Leics. LE11 3TU, UK

**Abstract**

Experimental deposition efficiencies for deposition from laminar flow in fibrous filters containing variable numbers of layers were obtained by Jackiewicz *et al* (2008). In the work presented here a particular case of their data for deposition onto filters with 1 to 9 layers is analysed in detail. Its dependence on layer depth is shown to be remarkably similar to the dependence on length of diffusive deposition from similar laminar flow in a cylindrical tube of a chosen radius. The observed mean layer deposition is shown to be consistent with theoretical predictions of deposition by diffusion and interception in the standard cell model. A reason for a larger than average deposition on the first layer is that many fibres in that layer remove particles from the initial particle concentration.

**Keywords:** Filtration; fibrous; diffusional deposition



## Introduction

A fibrous filter contains a tangled mass of fibres placed approximately perpendicular to the gas flow through them. Its efficiency, E, is the fraction of aerosol in the flow which is retained by deposition from the flow during its passage through the filter. Much work on understanding this deposition has been based on a cell model in which deposition on a single fibre is calculated (Kuwabara 1959, Dunnett and Clement 2006). Cells throughout the filter are assumed to be identical so that the initial efficiency of the filter with passage through m cells is just obtained from a product of cell efficiencies, $\eta$,

$$E = 1-(1-\eta)^m \qquad (1)$$

However, this approach will fail if, as a result of diffusion, the distribution of particles in the flow entering a cell changes significantly. The efficiency then becomes a function of distance travelled through the filter. Experiments to measure efficiency as a function of this distance were performed by constructing filters with different numbers of nominally identical layers of filter material by Jankiewicz *et al* (2008). They interpreted the depth dependent efficiency found in terms of “axial diffusion”. In this paper, by comparing the efficiency variation with that occurring in laminar tube flow, we show that a much more convincing