

# Nanoparticle Collection by a Lab-Scale Spray Scrubber Designed for Fume Treatment under Incineration Conditions

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## Introduction

In flue-gas treatment line of hazardous waste incineration, the scrubbers are a technology dedicated to the absorption of acid gas. This technology also permits to collect a part of the particles contained in the flue-gas mainly by Brownian diffusion, impaction, interception, thermophoresis, diffusiophoresis or turbophoresis mechanisms. There are few experimental studies in the literature dealing with the performances of wet scrubbers regarding particle removal. Only one experimental study (Vasudevan *et al.*, 1985) is dealing with particle collection at operating conditions close to those encountered in waste incineration regarding in particular gas temperature (200°C). No experimental study is identified regarding nanoparticle collection.

The present study aimed to quantify the collection performances of a spray scrubber regarding nanoparticles, for representative incineration operating conditions and for similitude between the lab-scale and full size scrubbers encountered in flue-gas treatment line of waste incineration plants.

## Methods

A lab-scale spray scrubber was designed for the study of nanoparticle collection. The experimental set-up operates in realistic conditions to those found at the inlet of scrubber(s) of the flue-gas treatment line of waste incineration plant ie:

- i) scale similitude between lab scrubber and full scale scrubber in terms of ratio between liquid and gas flow rates, column height to diameter ratio, residence time of the gas, flow regime (i.e. turbulent regime), same droplet diameter ;
- ii) same temperature and humidity conditions: mixing ratio of 15% (g of water / g of air) and 200°C ;
- iii) particle concentration and distribution representative to ESP outlet in flue-gas treatment line of waste incineration.

The collection efficiency was quantified from particle counting (dilutors + SMPS Grimm) up and

downstream of the scrubber set-up during injection of carbon nanoparticles (DNP 2000 Palas) and alumina particles (RBG 1000 Palas).

## Conclusions

The results revealed significant performances of the spray scrubber with a minimum particle collection efficiency of around 50% for particle diameter of around 50 nm in electrical mobility. The experimental results were compared to the models in the literature.

The set-up allows investigating the influence of some operating parameters on the particle collection efficiency in order to optimize the operations in full-scale incineration plants.

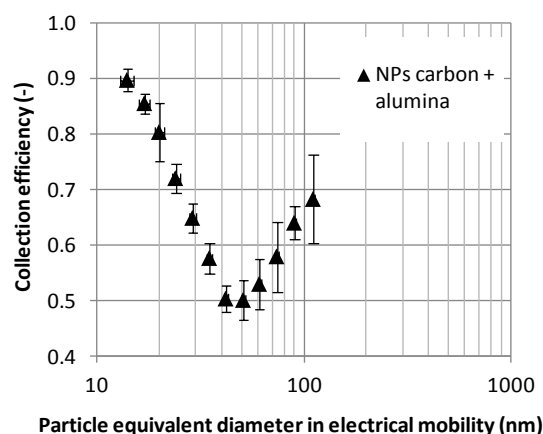


Figure 1. Experimental results of particle collection efficiency by the spray scrubber.

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Vasudevan, T. V., Gokhale, A. J. & Mahalingam, R. (1985). *The Canadian Journal of Chemical Engineering*, 63 (6), 903-910.