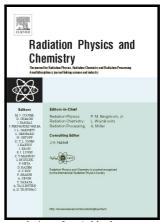
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www.elsevier.com/locate/radphyschem

PII: S0969-806X(17)31130-1

DOI: https://doi.org/10.1016/j.radphyschem.2017.11.005

Reference: RPC7688

To appear in: Radiation Physics and Chemistry

Received date: 26 October 2017 Accepted date: 11 November 2017

Cite this article as: Andrzej G. Chmielewski, Ewa Zwolińska, Janusz Licki, Yongxia Sun, Zbigniew Zimek and Sylwester Bułka, A hybrid plasma-chemical system for high-NO_x flue gas treatment, *Radiation Physics and Chemistry*, https://doi.org/10.1016/j.radphyschem.2017.11.005

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ACCEPTED MANUSCRIPT

A hybrid plasma-chemical system for high-NO_x flue gas treatment

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ABSTRACT

The reduction of high concentrations of NOx and SO₂ from simulated flue gas has been

studied. Our aim was to optimise energy consumption for NOx and SO2 removal from off-

gases from a diesel generator using heavy fuel oil. A hybrid process: electron beam (EB)

plasma and wet scrubber has been applied. A much higher efficiency of NO_x and SO₂

removal was achieved in comparison to dry, ammonia free, electron beam flue gas treatment

(EBFGT). A recorded removal from a concentration of 1500 ppm NO_x reached 49% at a low

dose of 6.5 kGy, while only 2% NO_x was removed at the same dose if EB only was applied.

For SO₂, removal efficiency at a dose of 6.5 kGy increased from 15% (EB only) to 84%

when sea water was used as a wet scrubber agent for 700 ppm SO₂. The results of this study

indicate that EB combined with wet scrubber is a very promising technology to be applied for

removal of high concentrations of NOx and SO₂ emitted from diesel engines operated e.g. on

cargo ships, which are the main sources of SO₂ and NO_x pollution along their navigation

routes.

Keywords: Electron beam irradiation; SO₂; NOx; Wet scrubber; Flue gas

Introduction

SO₂ (sulphur dioxide) and NOx (nitrogen oxides, mainly NO and NO₂) are harmful

pollutants which affect human beings and the biota. Exposure to these compounds is

dangerous to human life, causing respiratory diseases such as emphysema and bronchitis

[Kampa & Castanas, 2008]. Moreover, emissions containing SO₂ and NO_x, when released

into the atmosphere, result in acid rain, which destroys historic monuments, sculptures and

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