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Radiation Technology Application in Environmental Protection

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Nitrogen oxides (NO_x), sulphur dioxide (SO₂), volatile organic pollutants (VOCs), polyaromatic hydrocarbons (PAHs) and dioxins are still main air pollutants. They are mostly formed during fossil fuels combustion, solid waste incineration or at other industrial processes. In recent years, cargo ships are the major emission source of SO₂ and NO_x emission generating very high concentrations of these pollutants in off gases.

Electron beam (EB) flue gas treatment technology for purification of gaseous effluents from coal fired boilers after testing in Japan, US, Germany, Poland, China and Bulgaria has been implemented in industrial scale in Pomorzany Power Plant, Szczecin, Poland. It is a dry scrubbing process with ammonia addition, high removal efficiency of SO₂ (> 90%) and NO_x (>70%) were obtained at 8 kGy absorbed dose, benign products were formed. EBFGT is also a very promising technology to remove SO₂ and NO_x from flue gas generated by oil fired burner plants what was demonstrated at the pilot test carried out in Saudi Arabian oil refinery plant using a mobile accelerator. High removal efficiency of SO₂ can be easily achieved at low dose, however it needs very high doses (i.e., high energy consumption) to obtain high removal efficiency of NO_x. EB technology combined with catalyst to increase removal efficiency of NO emitted from stationary source was investigated through computer modeling simulations. The feasibility to remove SO₂ and NO_x from off gases generated from cargo ship by using EB technology was investigated, preliminary results showed that EB technology might be used to remove SO₂ and NO_x from off gases emitted from cargo ship with presence of wet scrubbers instead of ammonia addition. NO_x removal efficiency was increased from 3% (EB only) up to 62% (EB combined with 4.5% salty water scrubbers) at 8.8 kGy absorbed dose at 90 Celsius degree for the initial concentration of NO_x being 1500 ppmv with 500 ppmv SO₂ presence. EB technology might be used for PAHs and other organic pollutants removal as well. Recently emerging organic pollutants have been detected in tap water or ground water, their persistence cause people's concern. Institute of Nuclear Energy and Technology (INCT) researchers have studied perfluorinated organic compounds (perfluorooctanoic acid as a representative compound) destruction in aqueous solution by using EB or gamma irradiation. It showed that more than 80% PFOA was decomposed at 5 kGy dose under gamma ray irradiation in argon-saturated solution of pH 2.0 containing 20 mg/L of t-butanol for initial concentration of PFOA being 1 mg/L; under EB irradiation, nearly 100% PFOA was decomposed at 105 kGy dose. In order to get better understanding decomposition mechanism of PFOA under EB irradiation, a computer simulation was carried out. Good agreement was obtained between calculation and experimental results.

Country/Organization invited to participate

Poland

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