Radiation Processing of Flue Gases

Flue Gas Treatment

- Flue gases (e.g., gases produced on burning of coal) contain oxides of nitrogen and sulfur (NO_x, SO_x)
- NO_x and SO_x are harmful to the environment (acid rain, damage to plants, detrimental to fish in lakes)
- Conventional methods (e.g., treatment with CaO) are cumbersome and only remove SOx
- The Ebara Process (electron irradiation of flue gases) can remove > 90% of both SO_x and NO_x

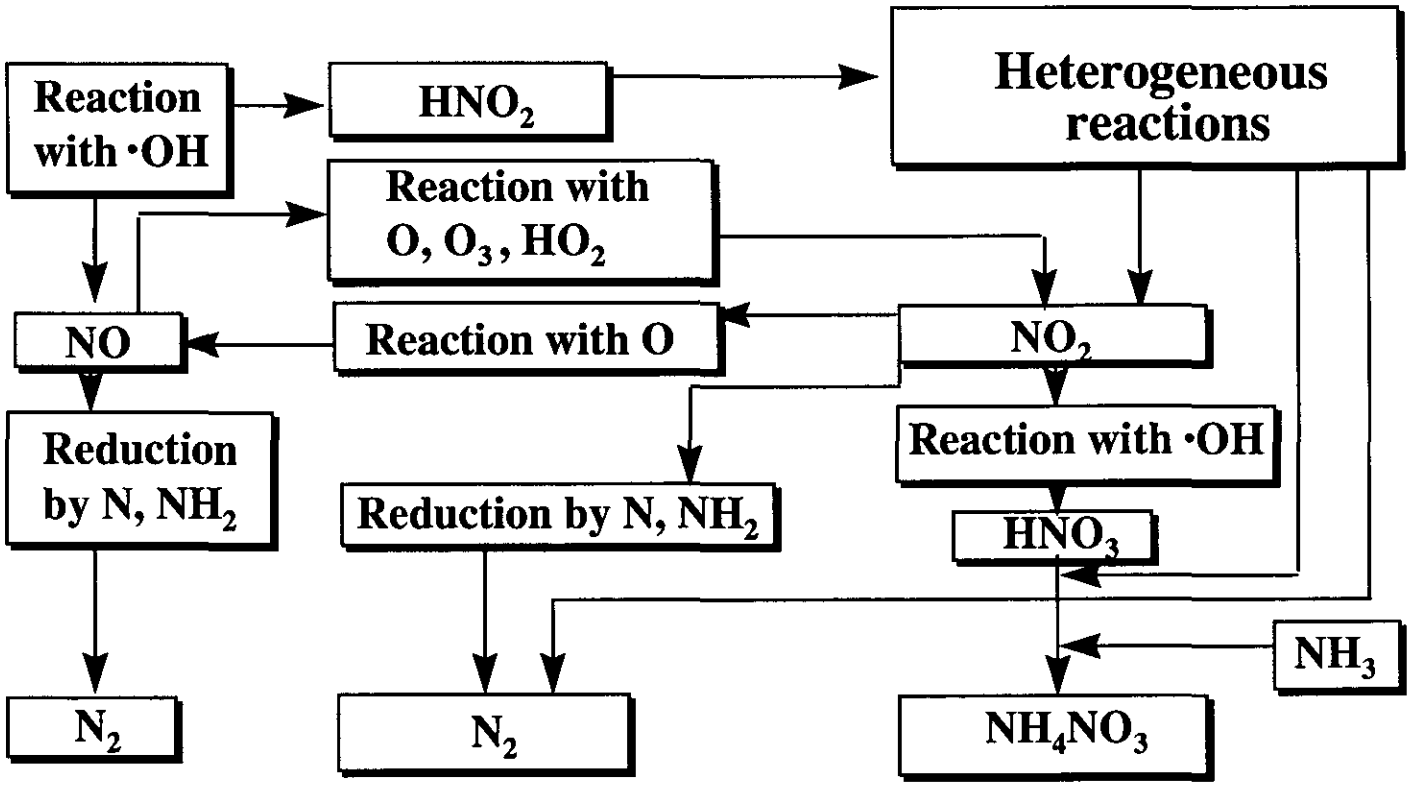
Essentials of the Ebara Process

- Conversion of SO_2 and SO_3 to $(NH_4)_2\ SO_4$
- Conversion of NO_x to NH_4NO_3
- Separation and purification of $(NH_4)_2SO_4$ and NH_4NO_3 for use as fertilizer
- A very large scale process for electron irradiation

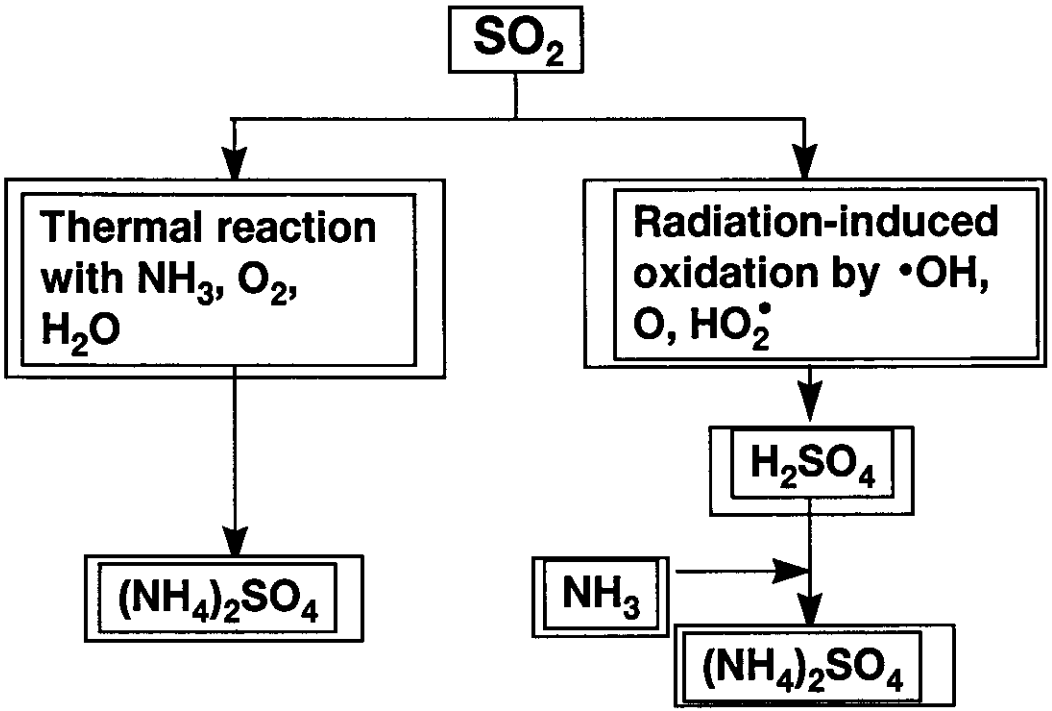
Demonstration Work on Flue Gas Irradiation

- Japan, Ebara Co., 0.75 MeV, 45 kW electron accelerator, 3-10x10^3 m^3/h flue gas treated, 10-15 kGy (1977-78)
- Indianapolis, USA, 1985; 0.8 MeV, 2 x 80 kW; 1.6 - 3.2 x 10^4 m^3/h
- Karlsruhe, Germany, 1985; 0.3 MeV, 2 x 90 kW, 1- 2x10^4 m^3/h
- Kaweczyn, Poland; 0.5-0.7 MeV, 2 x 50 kW; 2 x 10^4 m^3/h
- Commercial plant being built in Poland

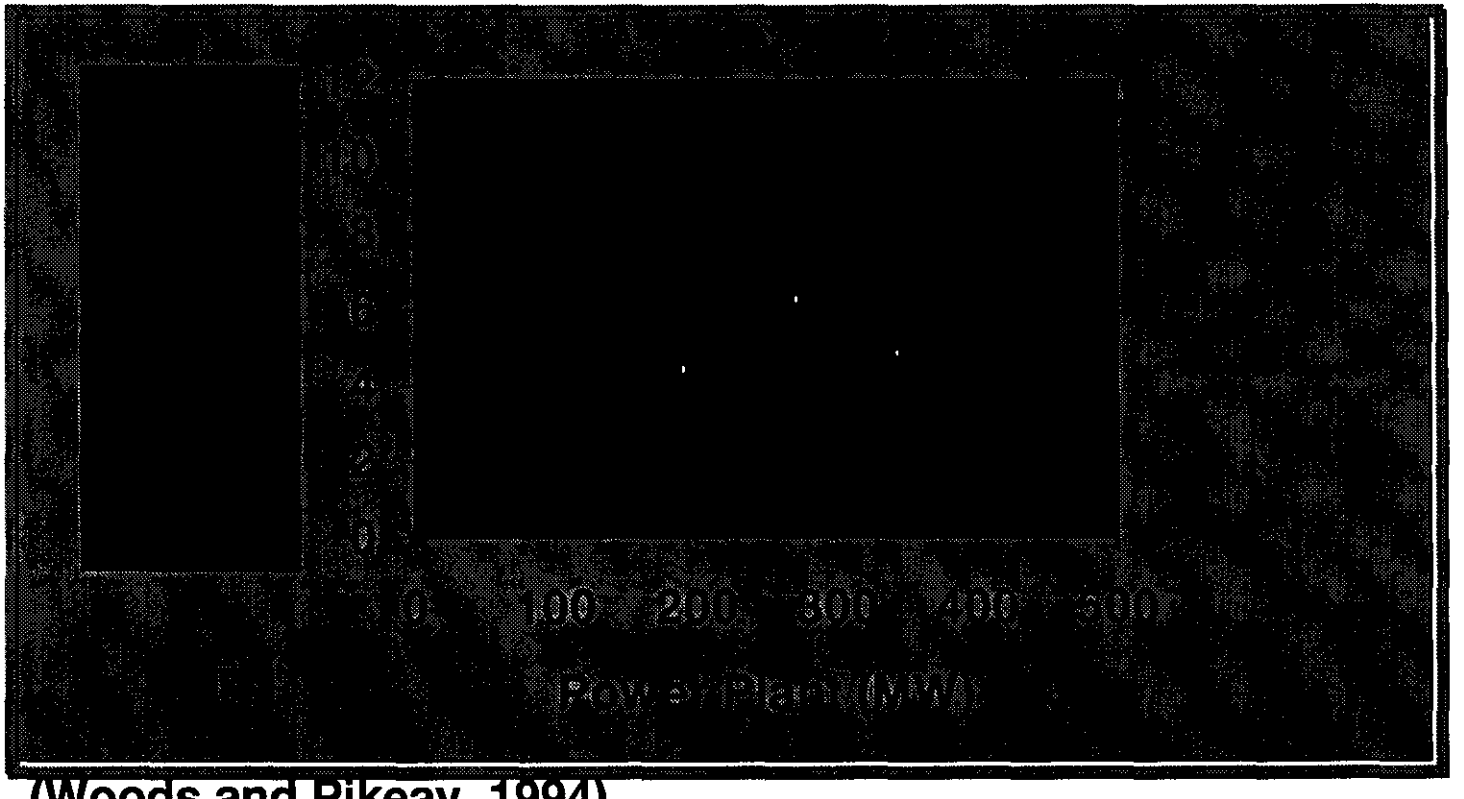
Main Reactions for the Removal of NO and NO_2 From Flue Gases (Ebara Process)



Main Reactions for the Removal of SO_2 from Flue Gases (Ebara Process)



Electron-Beam Power Required to Purify Flue Gases Using the Ebara Process



(Woods and Pikeav, 1994)

Future of Radiation Processing for Better Environment

- Increasing use of radiation processing for dealing with environmental pollution is warranted
- Sewage treatment, flue gas treatment and purification of drinking water potential candidates for radiation processing technology
- Reduction in cost of radiation processing (cheaper electron accelerators) would help increased use of radiation processing in these areas