IAEA Nuclear Sciences and Applications

Radiation Technologies: Contributing to a Cleaner Environment and Better Health Care

Flue gas: Electron beam treatment

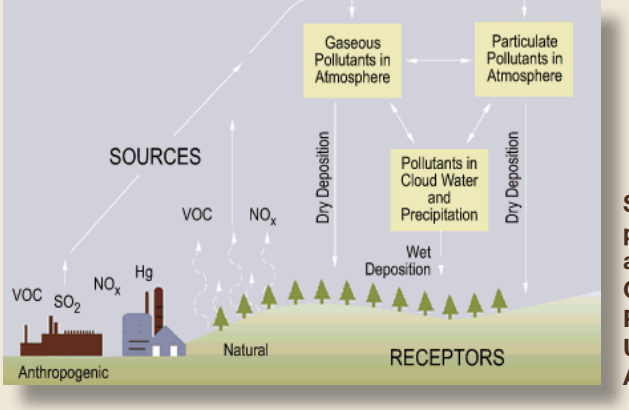
With support from the IAEA, industry is using radiation technology to clean-up fossil fuel emissions, or flue gas – converting pollutants into high quality fertilizer.

Each day, the world burns an average 6.2 billion metric tons of coal, one of the world's most abundant fossil fuels. Coal combustion is also the largest source of energy for the generation of electricity worldwide.

Composed of naturally occurring carbon, hydrogen and sulphur, fossil fuel emissions such as those resulting from coal combustion are the main contributors for global problems such as climate change and acid precipitation or 'acid rain' – a mixture of wet and dry deposited material from the atmosphere containing higher than normal amounts of nitric and sulphuric acids, as a result of emission contact with water vapour in the atmosphere.

In response to growing public demand for a cleaner environment, and the reliance on coal in the foreseeable future, industry is searching for new and effective ways to use coal more efficiently as well as to reduce emissions.

In this context, with support from the IAEA, radiation technology is being applied to fossil fuel emissions – known as flue gas – from coal burning and other industries, converting them into high quality agricultural fertilizer.



SO_2 and NO_x emissions play a major role in acid rain formation. Credit: Environmental Protection Agency/ United Stated of America.

Advantages and Challenges

- Electron beam simultaneously removes SO_2 and NO_x at high efficiency levels. A dry scrubbing process, with no slurry recycling or sludge disposal, it generates nether waste water or solid waste.
- However, large scale electron beam facilities that are reliable in harsh or polluted conditions are still required.

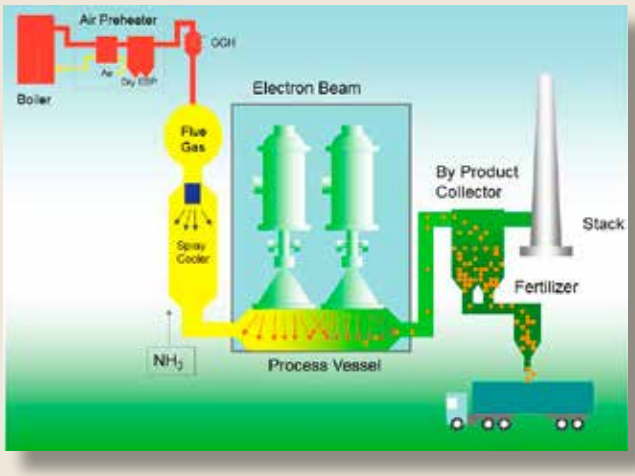
How it works

Traditionally, flue gas is filtered through separate chemical and physical processes for each pollutant, minimising air pollution, but creating waste water, sludge and solids. In addition, the process utilizes vast amounts of another important natural resource: water.

Radiation technology is a dry-scrubbing process that utilizes electron beams (EB) to treat pollutants, with considerable efficiency gains. Pretreated in an electrostatic precipitator, the flue gas is then cooled in a spray cooler and passed through a pipe, where it is exposed to electron beams. This simultaneously removes sulphur and nitrogen oxides (SO_2 and NO_x) with no waste generation. EB techniques for treatment of flue gas were originally developed in Japan in the early 1970s. Since then, the IAEA has facilitated coordinated development and adaptation of technologies dedicated to fossil fuel emissions in over 30 institutions and industries worldwide.

Success Story

Demonstration plants using the electron beam treatment technique have been built in Poland and Bulgaria, with partial support from the IAEA. Today, with 15 times the capacity of the original demonstration plant, an electron beam treatment plant in Poland efficiently removes from flue gas up to 95% of SO2 and 70% of the NOx, enabling the 60 MW (e) coal-fired power plant to comply with the SO2 and NOx emission limits defined by the European Union. Annual operational costs for traditional and EB methods are comparable – EUR 6 300 - 7 600 versus EUR 7 350 per megawatt, respectively. In addition, the by-product is a stock of high quality fertilizer pellets.



Scheme of the electron beam flue gas treatment (not to scale).

Nuclear Solutions for Development

Nuclear Science is all around us.

From power generation to medicine, nuclear science is in use.

In areas ranging from physics to biochemistry, in medicine and forensic science, in water management, in food production, and in the dating of fossils and identification of minerals, we harness the atom to maintain and improve our quality of living.

Fertilizers obtained as by-product of the electron beam flue gas treatment plant in Poland.

For more information on the IAEA's work in radiation technology applications in environment, please visit www-naweb.iaea.org/na/RIRT/

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