Clean air for Poland

Coal power generation produces gases which pollute the environment and cause damage to vegetation and human health. Where alternative sources of energy are not economically viable, the only solution is to ensure that gas emissions are reduced to a minimum. The Department of Technical Co-operation is sponsoring a programme with the support of the Department of Research and Isotopes to demonstrate a technology which will show Poland, and possibly other countries, a way to attain European emission standards without the need to compromise industrial growth.

Environmental concerns

When fossil fuels are burned, the gases which are emitted as SO_2 and NO_X are transformed by photochemical conversion in the presence of atmospheric moisture to sulphuric and nitric acids, or "acid rain". Not only does acid rain destroy vegetation and buildings but the free gases are also believed to contribute to "global warming".

In countries, such as Poland, where power generation is based largely on the burning of coal, the atmosphere surrounding power plants has become heavily polluted, damaging surrounding forests and threatening the health of the population among whom the incidence of respiratory diseases is abnormally high.

Most nations around the world are now committed to limiting gas emissions from power plants and recent global treaties require all countries to pass and implement laws limiting national SO_2 emissions. NO_X removal will also become compulsory in due course.

Power generation in Poland

Poland has vast stocks of coal, estimated at over 14 billion tons and the mining industry provides a livelihood for hundreds of thousands of people. Furthermore Poland has no economically or technically viable alternatives to burning coal for power generation. The only solution is therefore to remove the noxious gases by the most cost-effective means possible in order to prevent them from escaping into the atmosphere.

Credit: PAP/CAF R. Koszowski

Thousands of jobs in Poland depend on clean use of domestic coal.

Flue gases may be an environmental health hazard many hundreds of miles from their source.

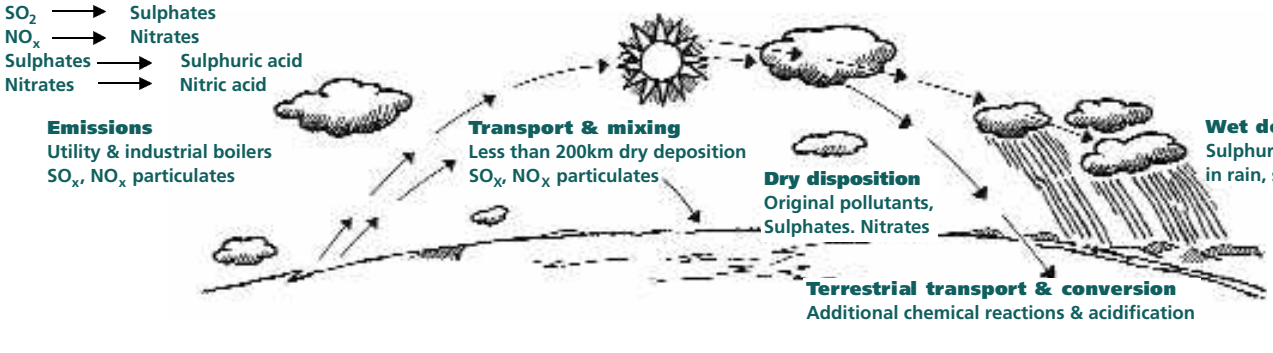
The Model Project

Based on a pilot project supported by IAEA at Kaweczyn in Poland another technical co-operation project started in 1995. An industrial scale demonstration plant for electron beam purification of flue gases is being constructed at the Pomorzany power station in the heart of Poland's northern industrial region near the port of Szczecin.

- Capacity: 300,000m³/h
- Operational from: 1999
- Cost: Approx $20 million of which 60% is being contributed by the Government of Poland and the remaining 40% by Japan, the Republic of Korea and the IAEA.

The pilot scale plant at Kaweczyn (Capacity 20,000 m³/h) achieved a removal efficiency of over 90% of SO_2 and 70-90% of NO_X using the electron beam process. This level of efficiency meets the most stringent regulatory requirements.

The economics of the process have been studied for various kinds of fuels which have different SO_2 and NO_X concentrations. The process has proved to be competitive with all existing SO_2 removal systems. It has already been shown that the higher the SO_2 content the more economical the electron beam process becomes, especially when taken in conjunction with the costs of also removing NO_X.



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Conventional technology

Separate methods have been developed over the years for removing SO_2 and NO_X. SO_2 is removed by 'wet scrubbing' and NO_X by catalytic reduction but neither system can be adapted to remove both gases. Furthermore, these are expensive processes to install and operate, especially for small and medium size boilers and they produce large quantities of waste water which must itself be disposed of after treatment.

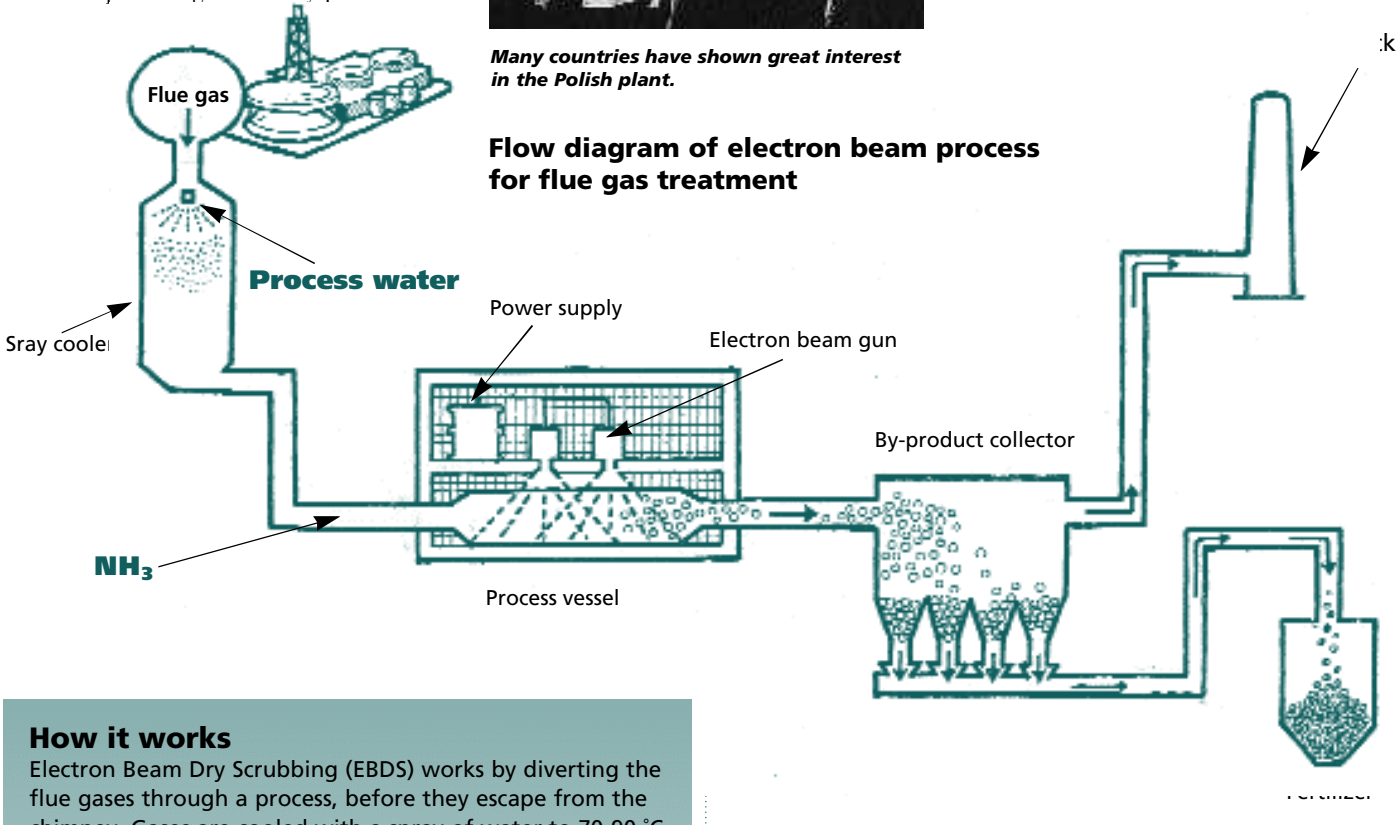
Electron beam technology

The electron beam process allows simultaneous and effective removal of both pollutants. It is less costly and produces less waste than conventional techniques. Furthermore, it is a safe and proven technology which has the added benefit of producing a useful by-product.

The electron beam process is not new. It was developed, principally in Japan, Germany and the USA, some 20 years ago, but by the time it became available for industrial scale application, most older coal-fired power plants had already been fitted with other scrubbing devices. However, it is less costly to install and operate than conventional systems, and meets the most stringent regulations. Furthermore, because ammonia is added to the wet flue gas, the end product of the scrubbing process is a fertilizer which has significant agricultural value. Tests have shown that the compounds produced compare favourably with commercial fertilizers. Because what would have been atmospheric pollutants are turned into useful fertilizer, there is less waste to be disposed of than in conventional processes.

Many countries have shown great interest in the Polish plant.

Flow diagram of electron beam process for flue gas treatment



How it works

Electron Beam Dry Scrubbing (EBDS) works by diverting the flue gases through a process, before they escape from the chimney. Gases are cooled with a spray of water to 70-90 °C. Ammonia is added to the wet flue gas which is then exposed to low-energy electron radiation from an accelerator. As a result, the toxic SO_2 and NO_X are transformed into other chemical forms and the aerosols which form are collected in a filter. Although it is a radiation process, no radioactivity is produced in the operation and there is no residual radiation.

The use of accelerators for radiation processing technologies, such as cleaning up flue gases, is a reliable and simple technology. The systems are easy to install, use and control and they are safe for operating personnel and the environment. When the system is switched off, there is no residual radiation.

The future

The Model Project in Poland has created interest elsewhere in the world as many countries generate power by burning coal. China has plans to introduce EBDS and other countries considering introducing the process include: Brazil, Bulgaria, Chile, Japan, India, Indonesia, the Republic of Korea, Malaysia, Mexico, Singapore, Thailand, Ukraine and the USA.

With the growing interest in environmental protection, the electron beam process is another example of a peaceful use of nuclear energy. It provides an economically, technically and environmentally acceptable method of continuing this form of coal power generation while at the same time ensuring clean air for people and the environment.

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