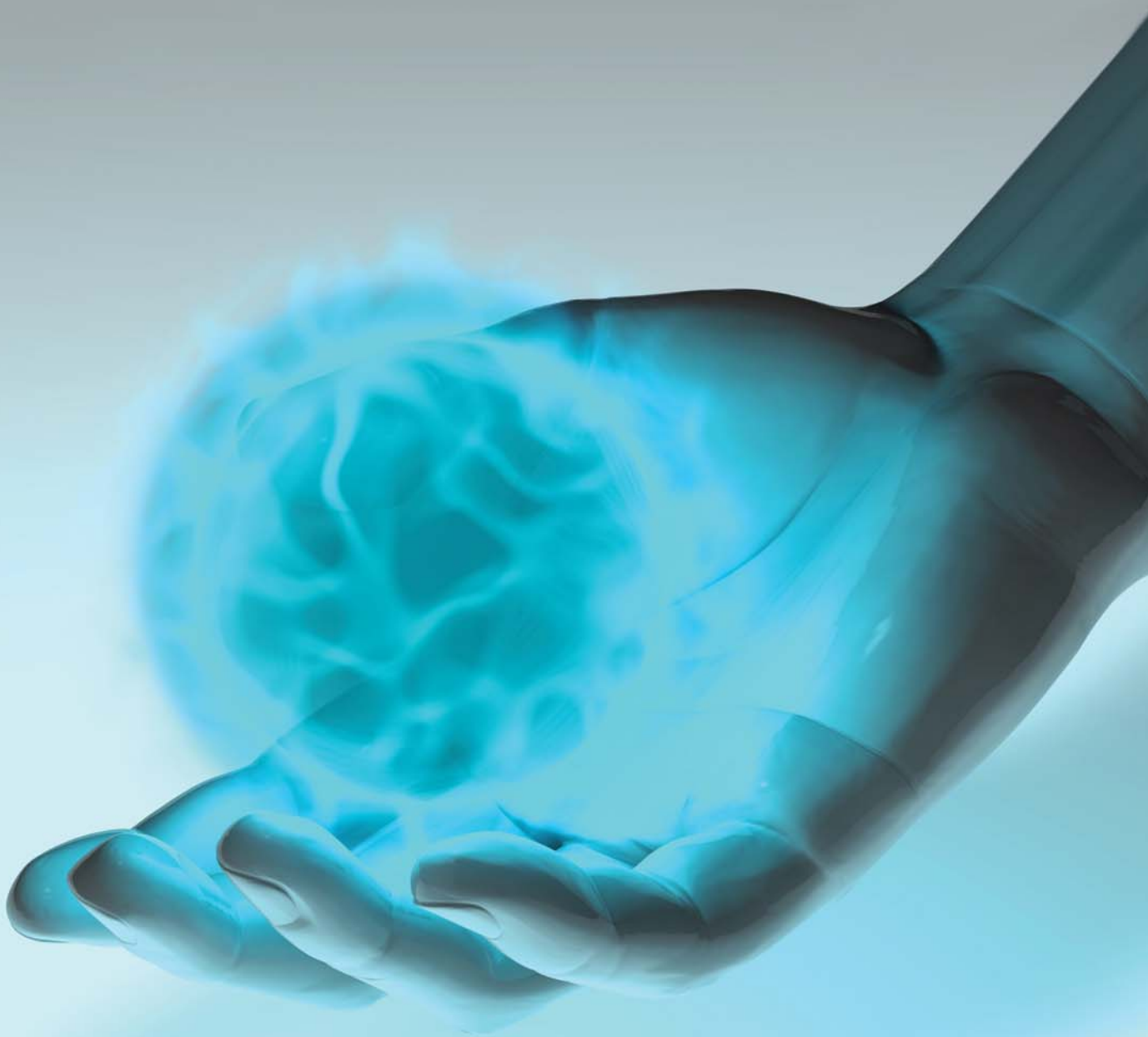
2010

# NUCLEAR

## TECHNOLOGY INTERNATIONAL



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# NUCLEAR TECHNOLOGY REDUCES ENVIRONMENTAL IMPACT

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Those of us who have been in the nuclear industry for a long time are pleased to see the resurgence of nuclear power. This resurgence is good for the planet and for people because it can improve the safety, environmental impact, and cost of producing power for the ever-growing demand in industrialised and emerging countries around the world.

It is imperative that we find the means of meeting our growing energy demands while maintaining a healthy and clean environment. Nuclear energy has the ability to provide large quantities of affordable energy with virtually zero carbon emissions. It should be part of an overall solution that also includes clean energy from more conventional fossil fuels that provide most of the world's power today.

## PROMPT-GAMMA NEUTRON ACTIVATION ANALYSIS (PGNAA) IS BASED ON PROMPT EMISSION OF GAMMA RAYS FROM ATOMS THAT HAVE ABSORBED NEUTRONS

Nuclear technology has been also applied to many other disciplines including nuclear medicine and materials analysis in laboratories, at mines, and at processing plants. Prompt-gamma neutron activation analysis (PGNAA) is based on prompt emission of gamma rays from atoms that have absorbed neutrons. This mature technology provides significant operational benefits in coal mining, generation of power from coal, production of cement, mining, and processing a variety of minerals such as iron. It provides a measurement of material composition that enables real-time control of process parameters that affect product quality, efficiency of power

On-Line Analyser at Coal Mine

production and power consumption. The benefits also include reductions in cost, energy use, and carbon-dioxide emission.

In the production of cement, there are three proven important fundamental operational uses. About 20% of the analysers in place today are used to create graded raw material stockpiles for further processing. The other 80% of the installations are for dynamic control of the raw materials mixture prior to grinding and firing in the kiln. In this application, the analyser is used to monitor and control the use of additives to achieve a desired end quality. Improved material uniformity leads to extended kiln life, reduced energy consumption, and savings in use of expensive additives. The third use is an emerging lab-type application of the technology to manage raw material extraction from the quarry at the front end of the process by making quick measurements of gallon-size samples placed in an analyser in the quarry. There are additional potential uses for the PGNAA technology at cement plants such as monitoring of coal as it is fed into the kiln, real-time analysis of partially cooled clinker,

and analysis of the final product as gypsum is added prior to shipment to the customer.

Currently, cement production consumes 1% of the world's energy and emits large amounts of carbon dioxide into the atmosphere. With several hundred PGNAA analysers currently deployed in cement plants around the world, this nuclear technology has proven itself as an effective means for reducing emissions and energy consumption while extending the life of kiln refractory, conserving the use of expensive product additives, and significantly reducing the variability of product quality. The key to all these benefits is the real-time process control of elemental composition made possible by the ability to "see" into the raw materials with the eyes of an instrument based on nuclear physics. The use of PGNAA technology has proven that there is a significant price tag associated with process variability and that reducing that variability results in significant savings.

As an example, PGNAA is used to control the composition of material from the quarry that enters the grinding mill and then the kiln. The improvement in composition uniformity through the use of an analyser leads commonly to a 50% reduction of variability. This in turn can translate into a 4% to 10% reduction in the total energy normally used that in many cases can help pay for the instrument in a few months. These improvements can also yield a reduction in carbon dioxide emissions both from burning less fuel and from a better control of the chemical reactions during production of clinker. This technology is quickly becoming a production standard for cement plants globally, and it is believed that every cement plant in the world can benefit from installing these analysers.

## MANY OF THE HERETOFORE DIFFICULT TO MANAGE PROCESSES CAN BE COMPLETELY MASTERED

As in cement production, the technology has several key applications in mining and burning of coal. The primary use for PGNAA at a coal mine is to provide real-time control of coal composition for keeping coal quality consistent over an entire train or barge and ensuring that the quality is precisely what the customer ordered. At coal mines, the technology is also used to create stockpiles of coal with known sulphur or ash qualities. This information is used in turn to make a train or barge load-out scenario more effective. There are also other potential uses of PGNAA at coal mines. They include the applications to divert coal around the washing process for saving cost, to manage the coal washing process better, and potentially to be used underground in the mining process for reducing the amount of rock taken from the roof or floor in the removal process.

Today, over 50% of the energy consumed in the US comes from coal. At a coal-fired power plant, a real-time analyser can ensure that the incoming coal is uniform and meets specifications. A large percentage of those coal burning power plants are involved in ongoing struggles to optimize their boiler operation and to minimize boiler shutdowns. Analysers can be used to control blending of different coals to provide a product that is uniform in composition and energy value for better control of the boilers, which in turn leads to better efficiency of power generation and better control of emissions. In many cases it can also mean fewer unplanned boiler outages which can be very expensive. In addition, PGNAA can provide real-time analysis of ash composition for managing burn parameters and controlling conditions that could lead to slagging or fowling. These conditions have major impact on power generation efficiency and, therefore, on the cost of delivering power to customers.

Lab Analyser for 4-litre Sample

Even with a dramatic increase in nuclear power generation around the globe, coal-fired power generation may also continue to increase in order to be able to fill a growing energy demand. It is imperative that coal-fired power plants operate efficiently and cleanly. Some benefits that analysers can provide for power generation with conventional coal-fired plants are described above. New clean coal technology will also experience similar benefits from the use of real-time nuclear elemental analysers for measuring both coal and limestone used in the boilers. Many of the heretofore difficult to manage processes can be completely mastered, thus benefiting all of us through improved material quality, reduced energy consumption, and reduced pollution emissions. ■

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