Thursday, 8 January, 2015
EU-funded project MU-STEEL has developed a system to detect radioactive materials hidden away in scrap metal destined for recycling. The system is safer and quicker than ones that use gamma rays or X-rays to detect contamination, the project says. A truckload of scrap can be given the ‘all clear’ in 30 seconds – helping recyclers save time and money while ensuring the safety of their workers.

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Muon radiation image of scrap metal cargo holding a radioactive source within a shielding container, after an exposure time of 5 minutes

An increasing proportion of the steel we use every day is recycled from scrap metal. However, sometimes that scrap may conceal a hidden danger – radioactive materials that should not be there in the first place.

If radioactive material is mixed unnoticed with the steel during processing, the result could be the accidental contamination of steel plants and products, exposing workers and customers to potential
health risks. For steelmakers, the costs could also include plant shutdowns, clean-up and potential recalls of contaminated products.

The contamination can happen when scrap metal is collected that includes radioactive sources that are difficult to detect – for example, the gauges used in some manufacturing operations and hospital equipment that are shielded to protect people while in use.

At present, the detection of such shielded radioactive materials in scrap requires high-power X-rays or gamma rays to penetrate the protective coverings. This process must be done in highly protected areas to keep workers safe from exposure to X-rays or gamma rays, depending on the system used.

As a safer, quicker alternative, MU-STEEL developed a detection system that uses ‘muon’ radiation to identify the highly dense materials in scrap metal – the protective casings shielding radioactive materials.

Within 30 seconds of entering a MU-STEEL detection chamber, a truckload of scrap metal will either be given the green light, or held for further investigation if potential radioactive shielding is discovered, says Giuseppe Bomben, an engineer with Italy-based Tecnogamma, which coordinates the project.

The project has produced a mechanical layout, a detailed design of a suitable muon detector and the first prototype. It has also developed a software package for the system and completed an extensive analysis of the technique’s potential use by industry.

**Natural radiation**

Muons are elementary particles that are similar to electrons, but have far greater energy and mass (about 200 times heavier). Around 10 000 muons cascade down onto each square metre of the Earth every minute following collisions between cosmic rays and air molecules in the atmosphere.

Muons’ mass and energy allow them to penetrate more deeply into matter than electrons. Muons will easily pass through a truckload of scrap metal, for instance, but if they encounter highly dense materials they will be deflected.

The MU-STEEL system measures muons above a scrap load. It then calculates any deflections by re-measuring those that pass below the load. Software, developed by the University of Padua, a project partner, provides inspectors with a three-dimensional image of material densities within a scrap load. This allows them to identify and locate potentially hazardous radioactive materials.

As it does not rely on dangerous gamma or X-rays, the system does not need to be housed in a protective bunker, and operators do not need any special training or protection, says Bomben. The system could be installed at a steelworks gate or border crossing to screen scrap, for example.

Systems to measure muon deflections were first developed in the search for the Higgs-Boson particle at CERN, the European organisation for nuclear research. The CERN muon detection chamber worked well, but it was prohibitively expensive. The Mu-Steel team used CERN insights and equipment to design a far cheaper prototype detection gate.

Most of the components of the MU-STEEL system are commonly available, helping to lower the cost, says Bomben. Research being done after the project ended in December 2012 now focuses on automating the production of components and reducing the cost of the muon detection chamber still further before the former partners put it on the market.
Project:
Muons scanner to detect radioactive sources hidden in scrap metal containers

Project Acronym:
MU-STEEL

Project website:
http://www.tecnogamma.it/contact.html [2]

Contact:
Contact [3]

Source URL:

Links
[3] mailto:mermectv@mermecgroup.com