Non-destructive assay of mechanical components using gamma-rays and thermal neutrons

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The non-destructive assay is an essential approach whenever a piece of equipment, device, or component should not be submitted to a destructive or invasive procedure due to safety reasons, high costs or other physical or logistics constraints. Within this frame, transmission radiography with gamma-rays and thermal neutrons are unique techniques to inspect an object and unveil its inner structure thanks to their capability to pass through a wide range of materials employed in the manufacturing industry. Roughly, as a rule of thumb, gamma-rays are more attenuated by heavy materials, while thermal neutrons are attenuated by the light ones, making them complementary tools. This work presents the results obtained in the inspection of several mechanical components through neutron and gamma-ray transmission radiography. The 4.46 x 10^5 $n.cm^{-2}.s^{-1}$ thermal neutron flux available at the main port of the *Argonauta* research reactor in *Instituto de Engenharia Nuclear* has been used as source for the neutron radiographic imaging. The 412 keV gamma-ray emitted by ^{198}Au, also produced in that reactor, it has been used as interrogation agent for the gamma radiography. Imaging Plates - IP specifically designed to operate with thermal neutrons [1] or with X-rays have been employed as detectors and storage devices for each of these radiations. These devices exhibit several advantages with regard to the conventional radiographic film. Indeed, besides a higher sensitivity and reusability, a dark chamber and a cumbersome chemical processing is not required for the development. Instead, it is carried out by a laser beam which interrogates the electric state of the crystal lattices of the IP, yielding a final digital image. Performances of both Image Acquisition Systems [2,3,4] rather constituted have been evaluated with regard to sensitivity, spatial resolution, linearity and dynamic range, including a comparison with the neutron radiographic system employing films and a Gd foil as the neutron-to-charged particle converter.

References

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