Contribution ID: **147** Type: **Poster**

# Performance evaluation of dual energy cargo container inspection system

*Wednesday 10 July 2019 16:35 (2 minutes)*

Cargo container inspection system uses megavoltage x-rays to detect illicit objects. We developed dual energy cargo container inspection system to decompose materials with different atomic numbers. The cargo container inspection system developed in this study generates MeV dual energy, 9 MeV and 6 MeV x-rays using a linear accelerator. Also, empirical dual energy calibration algorithm and a real-time dual energy calibration device were developed to discriminate organic and inorganic materials which represent low and high density objects. [1] In order to evaluate the performance of the developed cargo container inspection system, tests including penetration, wire detection, and material decomposition, were performed according to ANSI N42.46 standards. [2] Penetration testing is based on the ability to identify rhombus specimens made of steel placed behind 40 sheets of 600 mm by 600 mm with 10 mm thick steel plates, total thickness 400 mm. According to the ANSI N42.46 standards, the thickness of the rhombus specimen should be set to 20% contrast. Since the thickness of the steel plate was 400 mm, it should be 80 mm or less. As a result, we observed the shape of rhombus specimens behind the steel plate with 400mm of thickness from the x-ray images. Wire detection measures the diameter of the minimum identifiable copper wire. In order to perform the wire detection test, a steel plate of various thickness was placed in front of the copper wire, and a ring-shaped copper wire was identified from the X-ray image. Wire detection measurements were made for copper wires with various diameters, varying the thickness of the steel plate from 0 mm (in air) to 400 mm. As a result, it was possible to identify copper rings with diameters of 2, 2.5, 4, 6, and 15 mm for steel sheet thicknesses of 100, 150, 200, 250 and 300 mm respectively. The contrast within 5 % was calculated. In order to evaluate the material decomposition, the containers were filled with organic and inorganic materials such as tire, water, wheat flour, agricultural products, bolts, nuts and steel plates to determine whether the organic substances or inorganic substances were separated. As a result, the organic materials including tire, water, wheat flour, and agricultural products, were represented by the orange color and the inorganic based materials including klystron, bolts, nuts, and steel plate were represented by the blue color by applying pseudo-coloring scheme according to the calculation result of material selective coefficients.

[1] D. Lee, J. Lee, J. J. Min, B. Lee, B. Lee, K. Oh, J. Kim, and S. Cho, "Efficient material decomposition method for dual energy x-ray cargo inspection system,"Nuclear Instruments and Methods in Physics Research A, vol. 884, pp.105-112, 2018.
[2] ANSI, "American National Standard for Determination of the Imaging Performance of X-ray and Gamma-ray systems for Cargo and Vehicle Security Screening,"ANSI N42.46, pp. 1-26, 2008.

**Author:** OH, Kyungmin (Korea Atomic Energy Research Institute)

**Co-author:** Dr LEE, Byeongno (Korea Atomic Energy Research Institute)

**Presenter:** OH, Kyungmin (Korea Atomic Energy Research Institute)

**Session Classification:** Poster Exhibition 2, Posters ID 81 - 182, chair: Christer Frojdh

**Track Classification:** general