Testing of Puncture-Resistant Material for Protection of Beta Scintillator Detectors used at the Hanford Site

Ramon A. Colon Mendoza Florida International University • **Merlin Ngachin** Florida International University

Hanford's Routine Inspection

In the areas surrounding the Hanford Site, routine surveys are performed manually using hand-held beta detectors. Due to the low energy of beta radiation, the detectors are kept very close to the ground, with a maximum separation distance of 0.25 inches. Being in close proximity to the ground, shrubbery and grass causes the Mylar covers on the detectors to puncture on a routine basis. Puncturing of the cover causes stray light to enter the detector, making it unusable since these detectors are designed to be sensitive to weak light signatures caused by scintillation from radiation bombardment. It is therefore desirable to find a way to mitigate or completely avoid puncturing the thin Mylar film found in these detectors.

Hand-held ß-detector used at Hanford site.

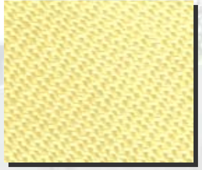
Obtaining the right material to protect the radiation detectors requires a tradeoff between puncture resistance and structural integrity of the protective device or its thickness and density. The approach to this problem will be to test several materials in two ways. The first would be by testing its transmissibility, the amount of radiation that can go through the material, and the second would be by testing its susceptibility to puncturing.

Experimental Set-ups

The isotope Sr-90/Y-90 with a half life of 28.8 years and maximum beta energies of 0.546 and 2.28 MeV was used as the radiation source.

Sample 1

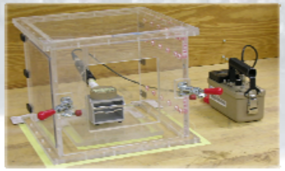
Sample 2



Sample 3

The testing materials selected for this research include bridal illusion (Sample 1), handkerchief-weight Irish linen (Sample 2), and cotton gingham (Sample 3). To test the transmissibility, the samples were placed layer by layer between the radiation source and the detector. The radiation source was placed at the center of a tray, 2.25 cm (0.89 inches) below the detector. To keep the exposure during the testing time as low as reasonably achievable (ALARA), the source, the pancake detector, and the material were enclosed in an acrylic box (1cm in thickness), and the entire experimental set-up is enclosed in a wood box (1.5 cm in thickness) with an open top.

Experimental Set-up



Enclosure

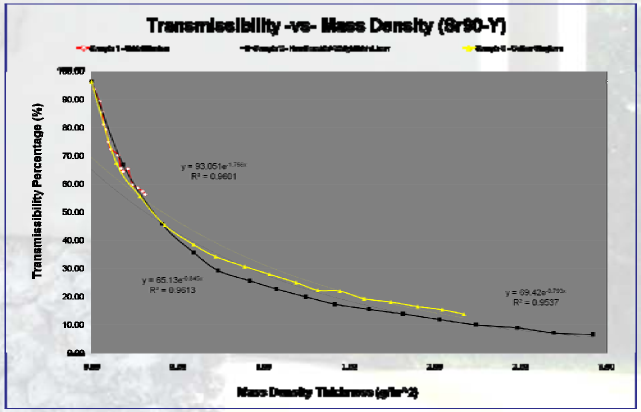
Transmissibility Results

The results obtained in this experiment will now allow us to have a trade-off between puncture resistance and transmissibility. The graph show the Sr/Y-90 β-transmission through the different materials. The mass attenuation coefficient was obtained using the Beer-Lambert's exponential attenuation law

$$I = I_0 \cdot e^{-(\frac{\mu}{\rho})\cdot \rho \cdot n}$$

	Attenuation Coeff.
Sample 1	1.756
Sample 2	0.845
Sample 3	0.793

Where $\frac{\mu}{\rho}$ is the mass attenuation coefficient, and ρ the density of the material in g/in^3.



Future Work

- Use a different β-energy sources for transmissibility check.
- Start the puncture testing series.
- Compare and choose which is the best trade-off between the three material tested.

Acknowledgments: *Dr. Leonel Lagos, Cristian Acevedo, Lee Brandy, Prasanth Gudavalli, Aditya Kolapalli & Jose Vasquez*