

NuSAG (Q3): Some data are presented for the variation of absorbance vs. time for Gd-loaded Scintillators. Are data available for possible deterioration of the scintillation light output of the scintillator vs. time?

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In 2004, Solar-Neutrino/Nuclear-Chemistry Group in BNL began to center its efforts in developing the Gd-loaded liquid scintillators for the newly proposed, high-precision theta-13 experiments, as an expansion of our R&D of chemical techniques for synthesizing metal-loaded organic liquid scintillator for LENS-Sol (~10% of indium by weight in LS) since 2000. In late 2004, samples of 0.1%~0.2% of Gd by weight in LS with excellent optical transparencies (~15 meters of  $1/e$  attenuation length) and high light output (~95% of pure pseudocumene, PC) were successfully prepared. By the experience learned from recent reactor experiments (for example, CHOOZ has to be shut down due to its detector aged at 0.4% per day or >100% per year), it is clear that the most critical ingredient for a long-run (>3 years) antineutrino detector is the stability of its key characters: optical transparency and light output. To examine the long-term chemical stability of our formulated Gd-LS, a quality control program (QC) is implanted to monitor the changes of attenuation length and light output of Gd-LS periodically since their synthesis. Similar to previously presented data of variation of absorbance vs. time, the light yields as a function of time for selected Gd-LS samples are shown in the Figure. To date, 1.2% and 0.2% of gadolinium in PC have been stable over a period of ~220 days. It is known that the stability of the Gd-LS also depends on the material of detector vessel in which it is stored, e.g., in acrylic. Palo Verde reported that the dilution of PC with other inert organic solvents could slow down the chemical attack of vessel although they still observed deterioration of their Gd-LS but at a more slow rate of 0.03% per day or ~10% per year. To preserve the stability of detector from the interaction of aggressive organic solvent, the 1.2% of gadolinium, originally synthesized in PC, was diluted with pure dodecane. The final formulation of Gd-LS under the QC is ~0.2% of gadolinium by weight in the mix of 20% PC and 80% dodecane. Its light yield shows no variation since preparation, ~50 days.

