Laser Scanning Confocal Microscopic Investigations of Simulated Nuclear Waste Structures

T. B. Calloway, Jr., R. L. Brigmon, W. E. Daniel, & R. E. Eibling [1)]

1) *Savannah River Technology Center, Westinghouse Savannah River Company, South Carolina, USA*

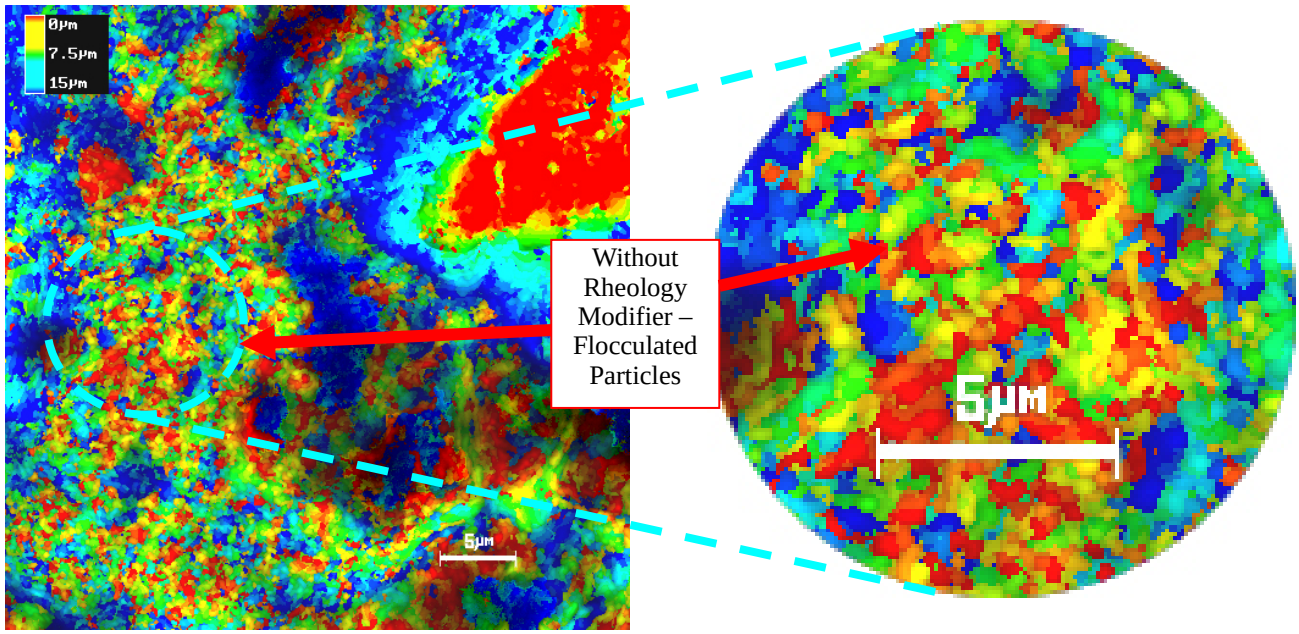

Fig.1. Three Dimensional Representation of Simulated High Level Nuclear Waste without Rheology Modifier

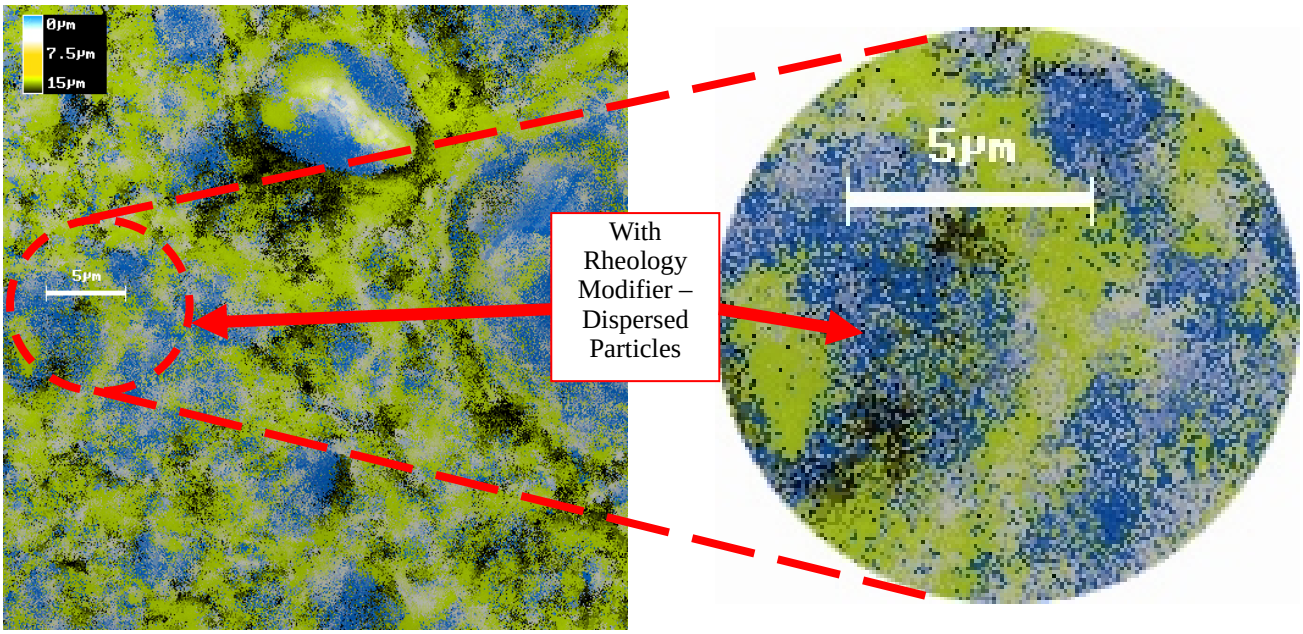

Fig.2. Three Dimensional Representation of High Level Nuclear Waste with 1000 ppm CTAB

Brief summary here and reference figures above.

Researchers at the Department of Energy's Savannah River Technology Center are using advanced microscopy techniques to understand the effects of trace organic chemical additions on nuclear waste slurry flow properties. Trace organic chemicals, surfactants (rheology modifiers), are being used in all types of industries to modify the flow properties of various commercial chemicals. Nuclear waste treatment at the Department of Energy's weapons production facilities, Savannah River Site and Hanford Reservation, is limited by the viscosity of the nuclear waste slurries as the material is processed through a variety of waste treatment and immobilization processes. Figure 1 shows a simulated nuclear waste slurry prior to the addition of rheology modifier. The

picture was taken using a laser scanning confocal microscope. This technique allows the slurry to be analyzed in an as-made condition. The microscope has the ability to make both two-dimensional pictures and three-dimensional representations of a sample. Figure 1 is a three-dimensional representation made by scanning two-dimensional images at 1-micron increments. Image analysis software, provided by Carl Zeiss, Inc., was used to stack the images together in a two dimensional image that provides a color gradient corresponding to the depth of the sample. These three-dimensional representations were used to understand the actual physical structure of the slurries. Figure 2 shows the same simulated nuclear waste slurry after addition of CTAB, a rheology modifier. Analysis of Figure 1 and 2 indicates that nuclear waste slurries may actually be composed of tiny particles that are flocculated by particle surface charges. Figure 1 shows the particles to be flocculated whereas Figure 2 indicates the rheology modifier, CTAB will disperse the particles. SRTC scientists and engineers are actively researching the effects of various rheology modifiers in the hopes of increasing throughput of currently operating nuclear waste treatment plants.