

Jeremiah McCord, Mechanical Engineering

University: University of Missouri-Columbia

Year in School: Senior

Hometown: Columbia, MO

Faculty Mentor: Dr. A. Sherif El-Gizawy, Mechanical & Aerospace Engineering

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Target test tube assembly process and design for the development of molybdenum-99

Jeremiah McCord and A. Sherif El-Gizawy

Molybdenum-99 (Mo-99) is used to create Tc-99, a widely used nuclear medicine diagnostic imaging radioisotope. In an attempt to decrease the need for imported Mo-99, development of mechanical systems to efficiently prepare low enriched uranium (LEU) sheets for radiation is needed. Once prepared, the LEU is radiated to create the Mo-99. This process involves layering the LEU foil between two aluminum tubes, swaging the tubes together, and then sealing the ends. The current design, a die and nut/bolt drawn punch swaging system, and using Tig welding to seal the ends is inefficient and inconsistent. The new mechanical system for the swaging process is designed to be efficient and eliminate any inconsistency. Detailed design of the proposed hydraulic concept was established using 3-D solid modeling software (Pro-Engineer) with 2-D views of non standard parts for future construction. The designed assembly was analyzed for accuracy and proper fits and the entire systems swaging operation was virtually simulated to check for potential errors. The required swaging force was determined through analytical analysis process and initial test measurements. Adequate cylinder, pump, and pressure gauge sizes were determined to exceed the minimum required swaging force. By using a horizontally mounted hydraulic jack to swage the tubes, the applied pressure will be monitored using a pressure gauge to insure a steady swaging force. This design utilizes a sliding die with removable end cap to ease the removal of the swaged tubes. This feature also assists in maintenance and the removal of jammed parts. Using an electron microscope, a gap between the swaged tubes was found using the current punch design. After extensive calculations, a new punch was designed to prevent any unwanted spring back induced gap in the aluminum. To reduce the inconsistency in the tube sealing process, concepts in cold rolling are being further studied.