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Pneumatic Tube System Sampler Sealer Design & Prototype for Neutron Activation Analysis (INAA)

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Neutron Activation Analysis (INAA) was discovered in 1936, since then this sensitive tool has been used to determine elemental compositions in a variety of sample matrices in the low parts per billion (ppb) range. Researchers at MURR, the Missouri University Research Reactor Facility, carry out this technique routinely. The process involves exposure of samples (target nuclei) to a source of neutrons. This interaction causes the sample to become irradiated and then release energy in the form of gamma radiation. The intensity and frequency of radiation enable both detection (identification) and quantification of the elements within the sample. A new system for delivering the samples to the reactor core for irradiating is being designed in order to make the process more efficient and to minimize the exposure of the laboratory technician to the irradiated samples which potentially might damage their health. The system we are developing is called the Pneumatic Tube System Sampler Sealer Prototype. This machine is in charge of mechanically sealing the samples inside a plastic capsule measuring 0.5 inches in diameter. Next, the capsules are pneumatically sent to the reactor core, where they are irradiated in the neutron flux. The samples travel through a tube that requires a constant flux of pressurized air. In the testing of the sealing machine it was found that a malfunction intermittently occurred due to the machine structure having non-wanted movement and that the heater was not designed to work in its current position. My responsibility was to redesign the sealer machine to reduce the sealing failure rate. Considering the errors that the present machine has, we have proposed a new design that consists of a structure with two parallel tubes; with this we hope to obtain a greater firmness and a reduction of unwanted and/or excessive movements. Secondly we decided to replace the heater with a new one that works in the correct position (down). Finally, we designed a rotating platform that allows us to have better efficiency in the capsule sealing process. The machine is now being manufactured and we soon hope to obtain encouraging results.

