

Sodium Reactor Cold Trap

Client: Dr. Akira Tokuhira – University of Idaho – Idaho Falls

In order to measure the velocity of sodium flow in the Argonne National Lab test loop, three elements are required: 1) a test section, 2) an economizer, and 3) an active cold trap. The proposed configuration of the system is shown in Figure 1. The past year's senior design team created a test section (Figure 2) that uses an ultrasonic transducer to measure the sodium velocity and includes a heater and controller to maintain the temperature of the sodium. An economizer (Figure 3) was also fabricated to remove and reintroduce heat into the sodium flow before and after the cold trap respectively.

The design goals for this year's team are to design and fabricate 1) an active cold trap that can control the amount of impurities in the sodium and 2) a test loop to validate the performance of the entire velocity measurement system.

Design Challenge – Active Cold Trap

Too many or too few impurities and the ultrasonic velocimetry will not get a good signal. The active cold trap must be able to collect the impurities by lowering the surface temperature of a part of the cold trap (called the cold finger) onto which the impurities will solidify. Warming the surface will release many of the particles, but an active control is needed to release all of the particles. One concept for the active control is to vibrate the cold finger in order to shake free the particles. Other concepts are welcome. While students will be producing a prototype, it must be shown that this design will be acceptable in the ANL test loop environment (materials, ASME boiler code, etc).

Design Challenge – Test Loop

A test loop is needed to validate the performance of the cold trap, economizer, and test section. The primary challenge is to measure the amount of impurities removed/added through temperature change in the cold finger and amount of impurities released by the active control. Sodium is not suitable for use in our labs and installing the equipment at Argonne without substantial testing is risky. The team can design the test loop to operate on one or more materials that exhibit desirable qualities, test all components together, or devise several test fixtures that each validates a part of the performance.

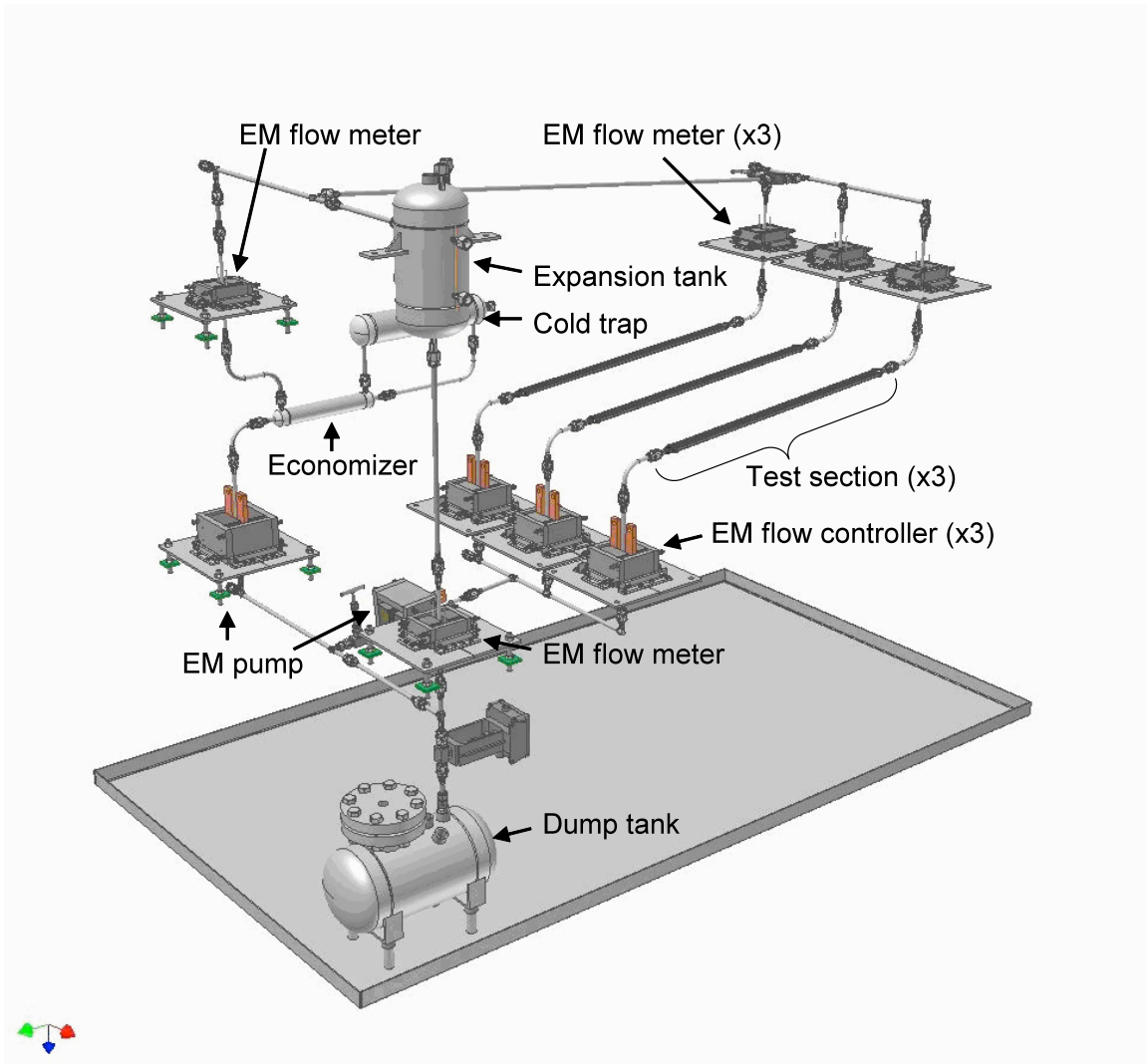


Figure 1. Schematic of small sodium loop facility at ANL.



Figure 2. Test section, heater, and control box.

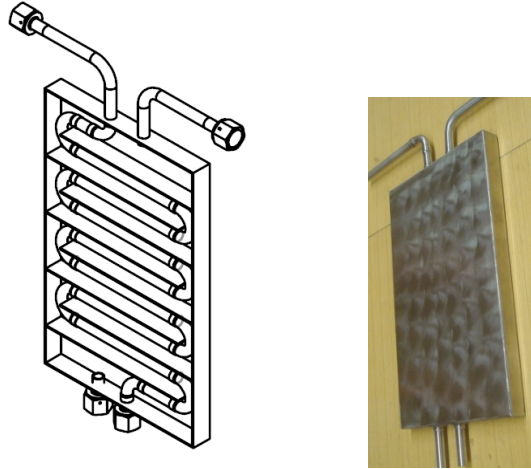


Figure 3. Cold trap economizer