

Methodology for Extraction of Remaining Sodium of Used Sodium Containers

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1. Introduction

Sodium used as a coolant in the SFR (Sodium-cooled Fast Reactor) reacts easily with most elements due to its high reactivity. If sodium at high temperature leaks outside of a system boundary and makes contact with oxygen, it starts to burn and toxic aerosols are produced. In addition, it generates flammable hydrogen gas through a reaction with water. Hydrogen gas can be explosive within the range of 4–75 vol%. Therefore, the sodium should be handled carefully in accordance with standard procedures even though there is a small amount of target sodium remainings inside the containers and drums used for experiment.

After the experiment, all sodium experimental apparatuses should be dismantled carefully through a series of draining, residual sodium extraction, and cleaning if they are no longer reused. In this work, a system for the extraction of the remaining sodium of used sodium drums has been developed and an operation procedure for the system has been established.

2. Composition of System

As a transfer process of the sodium experiment, the sodium of the containers is transferred to an experiment device. However, a small amount of sodium still remains in the containers after the process. There are some precautions before dealing with the remaining sodium. Workers who want to deal with the remaining sodium in containers must wear safety equipment because there is a danger of ignition by exposure in the atmosphere, which causes body injury by sodium particles scattering in the process of dismantling the sodium apparatus. In addition, all works must be implemented in the presence of a hazardous material safety officer. All experimenters should follow the directions of the safety officer who makes a plan to protect them from accidents. Also, fire protection gear has to be furnished in the job space where nonflammables and flame retarding materials are used for protecting from ignition and scattering ash. A crucial fact against fire is that only special extinguishing agents that meet the requirements by the fire safety regulatory body are applicable to a sodium fire.

The remaining sodium is transferred to the sodium storage tank by pressurizing the inner part of the drum with inert gas such as argon after melting of sodium. It is essential to use a device dedicated to extraction of sodium and cleaning of the drum because the remaining

sodium is not completely eliminated in a conventional way.

Fig. 1 shows the developed system for a more effective collection of remaining sodium from the used drum (200L).

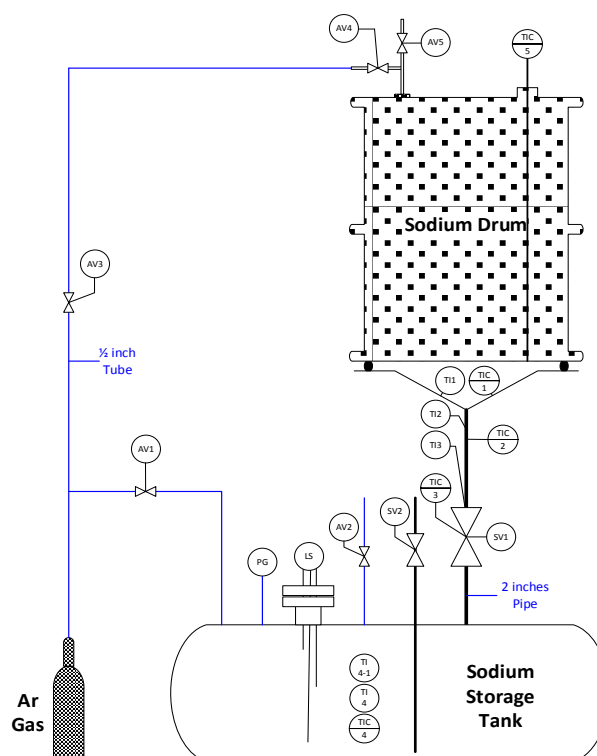


Fig. 1 The system for extraction of the remaining sodium of used sodium drum

The following is a list of the main components of the system.

- Sodium storage tank (for withdrawal only)
- Sodium drum (capacity: 200 L)
- Supply gas: Ar (purity: over 99.999 %)
- Level switch (LS) (3 ft)
- Temperature indicating controller(TIC) (0~300 °C)
- Pressure gauge (PG) (range: 0.0~1.0 kg/cm²)
- Ar(gas) valve (AV), Sodium valve (SV)
- Control panel

Fig. 2 displays a three-dimensional model of the system.

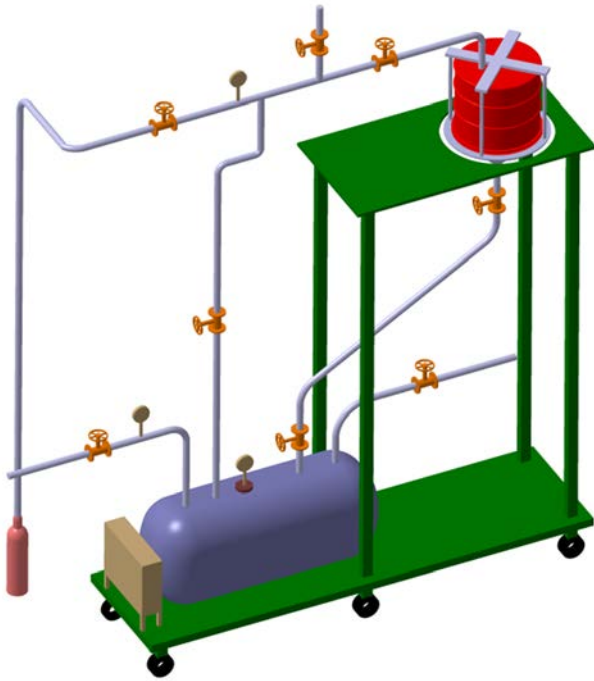


Fig. 2 Three-dimensional model of the system

3. System Operation Procedure

The system operation procedure for extraction of the remaining sodium out of the used sodium drum is shown in Fig. 3.

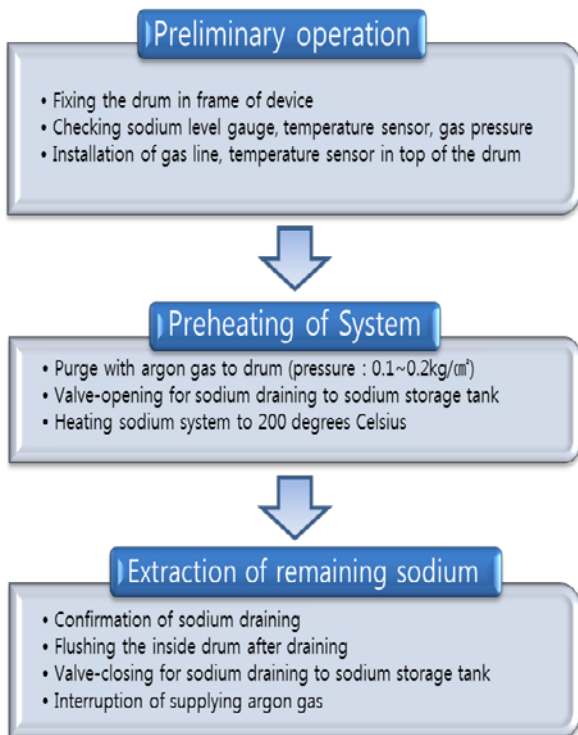


Fig. 3 System operation procedure for the sodium extraction

Methods for checking whether the extraction procedure is finished or not are as follows.

- Checking gas ventilation of sodium storage tank
- Checking the sodium falling sound
- Checking temperature change of sodium storage tank

After confirmation of the end of the drain procedure, flushing must be conducted by means of supplying argon gas to the drum (pressure: 0.1~0.2 kg/cm²) to drain the remaining sodium to the sodium storage tank completely. Then separation of a sodium drum from the system is needed in accordance with the following procedures after interruption of gas supply to the drum and pressure relief out of the sodium storage tank.

1. Cooling down the drum to room temperature by cutting off the power supply
2. Removal of gas line and thermocouple connected with the drum
3. Separation of the sodium drum from the system after sealing thoroughly

4. Conclusions

In this work, a methodology for the extraction of remaining sodium out of the used sodium container has been developed as one of the sodium facility maintenance works. The sodium extraction system for remaining sodium of the used drums was designed and tested successfully. This work will contribute to an establishment of sodium handling technology for PGSFR. (Prototype Gen-IV Sodium-cooled Fast Reactor)

ACKNOWLEDGMENTS

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