Newly Developed Technology Introduction: Radioactive Spent Resin Treatment System Using Combined Dewatering Hopper

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1. Introduction

The ion exchange process is well-developed and very effective to treat a large volume of radioactive liquid into a small volume of solid [1]. At the end of its life, spent ion exchange resin has to be replaced, transferred, provisionally stored and packaged and/or conditioned safely and efficiently. Regarding this, the present paper deals with a more simple and economic treating system using the Combined Dewatering Hopper which is to provide functions of dewatering, storing and evacuating spent resin in one body newly developed by DAEWOO E&C.

2. Technology Background and Application

There may be a number of technologies which has been studied, applied and improved from long before are available to treat spent resin; dewatering is effectively used as one of the conditioning method without immobilization together with volume reduction [2, 3].

In Korea, in some cases, spent resin was often dealt with cartridge type contained inside a steel pressure vessel (column) in the past. Though this method has the merit to simply replace it using a crane, there is a large possibility that a worker is exposed to the radiation emitted during a replacing operation of the cartridge. Thus, this method requires a crane for handling and storing the cartridge, an exclusive transfer cask for shielding.

In some nuclear power plants, spent resin has been sluiced from columns by hydraulic pressure and stored in some big tanks; after then evacuated, dewatered and/or dried and packaged. Because of remotely transferring and handling spent resin, this method may allow the worker to easily work and reduce the possibility of the radiation exposure. However, to perform container packaging or solidification treatment of the radioactive spent resin accommodated in the spent resin tank, a separate discharging and drying system capable of taking spent resin out of the tank and/or drying are needed. Although this is appropriate for treating a high activity level and a large amount of radioactive spent resin, this method may be inefficient to treat a relatively lower activity level and smaller amount of spent resin in consideration of the subsidiary facility and installation area [4].

As the developed treating method of the existing dewatering technology, this system is considered to transfer spent resin by hydraulic pressure and to dewater, store and evacuate spent resin into a package such as High Integrity Container (HIC) using the combined dewatering hopper in one; therefore, a separate spent resin discharge system and/or drying/solidification one are unnecessary and smaller space could be considered. This technology was applied as purpose-built design to Jordan Research Reactor and already commissioned expertly in 2016.

3. System Arrangement

Fig. 1 represents a system block diagram showing a brief configuration for treating spent resin using combined dewatering hopper.

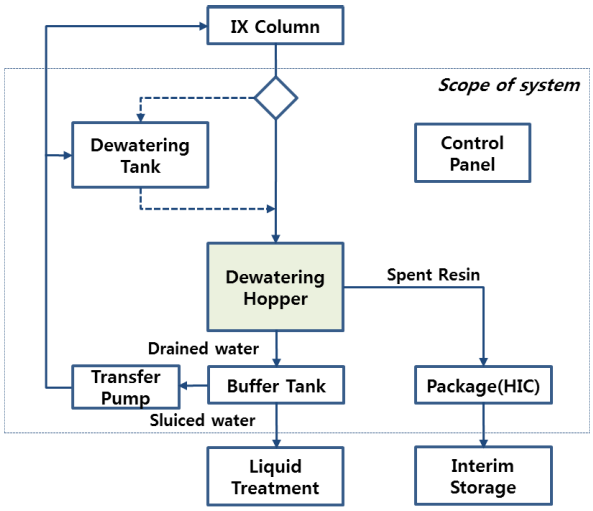

Fig. 1. Brief System Block Diagram.

Spent resin contained in an ion exchanger(IX) column which is comprised of a nuclear facility's purification system is fluidizing, pressurizing by

transfer pump(and/or with compressed air) and then evacuating by opening the control valve in system; the mixture of spent resin and water is sluiced into the combined dewatering hopper. Only water is passed through the screen and introduced into the buffer tank which is a water source of transferring spent resin. After evacuating work of spent resin from an ion exchanger is finished, water in buffer tank can be drained to liquid treatment system or recycled as fit for purpose. When the separation process on spent resin and water is completed in the hopper, evacuation process may be performed that spent resin is discharged into the package such as HIC etc. after a certain period of decay storage time.

In different with combined dewatering hopper in atmospheric operation, dewatering tank is designed additionally so that it performs pressurization in consideration of a long distance transfer.

4. Configuration of Dewatering Hopper

In Fig. 2, a schematic diagram of combined dewatering hopper is illustrated.

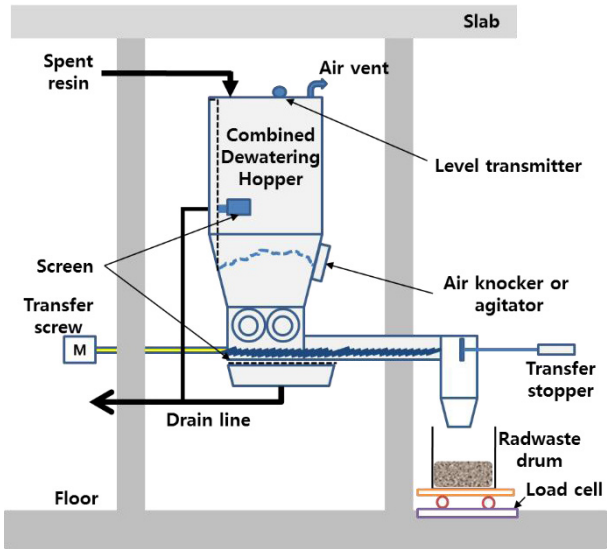

Fig. 2. Schematic Diagram of Dewatering Hopper.

The concept of this hopper is to reasonably combine the existing proven technologies such as transferring/dewatering spent resin hydraulically and screw discharging method etc.

This hopper is arranged at a shielded room and is mainly comprised of a housing customized by design capacity, screen of filter-type and/or plate-type for separating spent resin from sluicing water, a stirring agitator and/or a knocker as a bridge breaker, discharge unit for evacuating resin into a package which is equipped with a load cell.

Based on the research results using the pilot plant, it is estimated that free-standing water mixed in spent resin inside a hopper is removed less than 0.5 percent of the waste volume as free-standing water within 2 months in case of 1.2 m^3 of spent resin in a hopper in accordance with ANS 55.1 methodology; namely, free-standing water could be drained below the regulatory limit during decay storage by natural drainage [5].

5. Concluding Remark

This paper deals with a more simple and economic treating system using the Combined Dewatering Hopper which is to provide functions of dewatering, storing and evacuating spent resin in one body.

Although this technology has been currently applied only to research reactor, it is expected that it can be used in various forms of treating method for comparatively smaller amount and lower level of spent resin in the future such as small and medium sized reactors, small scale liquid radwaste treatment facilities etc.

REFERENCES

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