

Honeywell UOP

UOP IONSIV™ SELECTIVE MEDIA

Water Decontamination at Japan's Fukushima Daiichi Nuclear Power Plant

Case Study

UOP IONSIV™ SELECTIVE MEDIA:

Water Decontamination at Japan's Fukushima Daiichi Nuclear Power Plant

UOP IONSIV products are a proven route to superior cesium (Cs) removal. The products' high capacity and selectivity were demonstrated in full-scale application at the Fukushima Daiichi nuclear power plant after seawater introduced on-site was contaminated with Cs. IONSIV products have provided excellent Cs removal, with up to 90% less waste and minimal media replacements compared to other adsorbents, and have reduced Cs to non-detectable levels at the plant.

Background

The Fukushima Daiichi nuclear power plant is located in Fukushima Prefecture in Japan. In March 2011, a 9.0 magnitude earthquake caused a tsunami to flood the plant and seawater was retained within the sub-basement on the plant site. Failure of the cooling systems increased temperatures in the fuel rods, which resulted in the release of fission products into cooling water that subsequently flowed to the sub-basement. Accumulation of this water caused the water level in the basement to rise and threatened to overflow the site and discharge radioactive water into the Pacific Ocean.

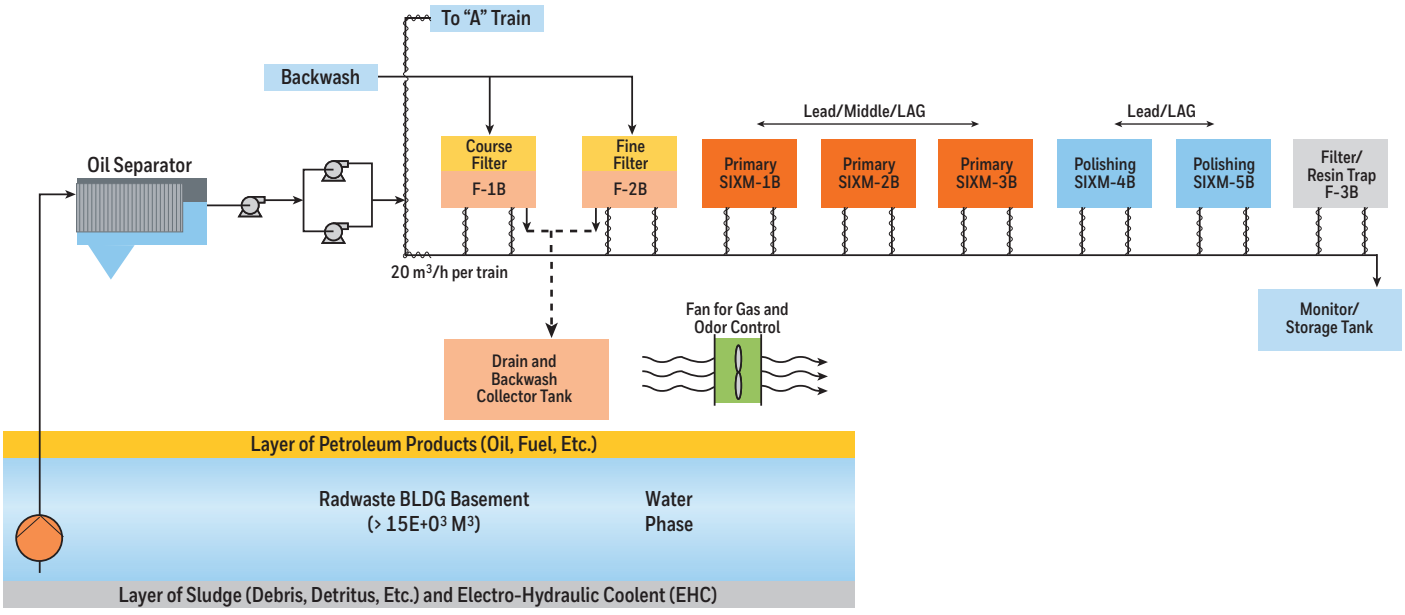
The water level in the sub-basement needed to be lowered to achieve hydraulic equilibrium between the water in the sub-basement and the external groundwater to prevent groundwater contamination. The water from the sub-basement could then subsequently be used in the recirculation loop needed for cooling the reactor core. Water treatment was needed to facilitate storage and beneficial use of water contained in the sub-basement.



Key Media Features

- High capacity results in minimal volumes of loaded media for subsequent storage/disposal
- High selectivity leading to effectiveness in saline conditions, improved downstream process performance and lower liquid waste and sludge volumes
- Single-use media, eliminating the generation of secondary waste streams
- Excellent mechanical, chemical and radiological stability allowing for application under a wide range of aqueous conditions

Figure 1 – SARRY System



Challenge

A water treatment system consisting of the following processes was originally installed:

- Oil/water separation
- Cs removal adsorption columns
- Media filter
- Dissolved air flotation
- Coagulation/flocculation/sedimentation
- Disk filtration/reverse osmosis (RO)

This treatment process did not achieve the desired level of Cs removal and resulted in carryover of chemical precipitates that fouled the RO pre-filters and membranes. Consequently, the RO system could not operate at full capacity and resulted in higher levels of radioactivity in the RO membranes that are undesirable for worker exposure. This treatment process also generated large waste volumes that are undesirable. UOP's IONSIV selective media was selected to improve cesium removal performance and minimize waste volumes.

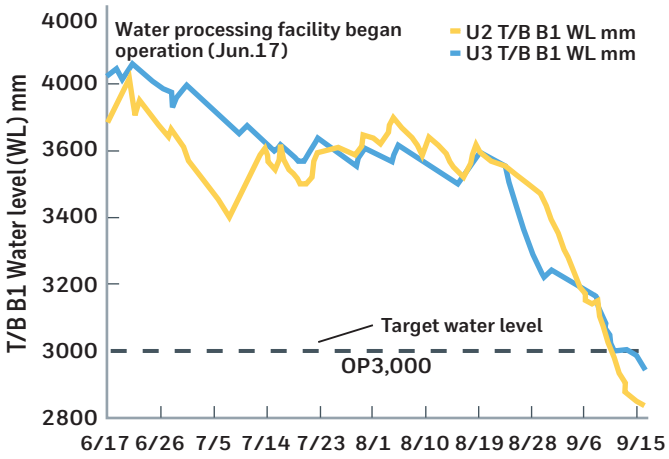
Solution

IONSIV R9120-B and R9160-G selective media are highly selective for Cs and were introduced into the Simplified Active Water Retrieve and Recovery System (SARRY™) system, which was developed by Toshiba Corporation, Shaw Global Services, LLC, and AVANTech, Inc. and is depicted in Figure 1. The Cs removal facility has treated over 500,000 m3 of water since its installation.

The IONSIV media outperformed the initial Cs removal facility by almost two orders of magnitude.

The greatly enhanced Cs removal allowed water in the subbasement to be treated to maintain the cooling loop as shown in Figure 2.

Figure 2 – Water Levels On Site in 2012



Outcomes

Application of IONSIV for cesium removal has resulted in essentially complete removal of Cs from seawater and achieved the following key outcomes:

- Reduced Cs levels by factors over 500,000 to non-detectable levels
- RO system has been able to operate at full design flows due to the fast kinetics of IONSIV and overall SARRY system design
- Media replacement costs and downtime for media replacement have been minimized due to the high capacity of IONSIV for Cs
- Waste volumes from Cs removal process in SARRY system have been reduced by over 90% compared to those produced by the Cs removal process in the original treatment system

For more information

For more information please contact your UOP representative or visit us online at www.uop.com.

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