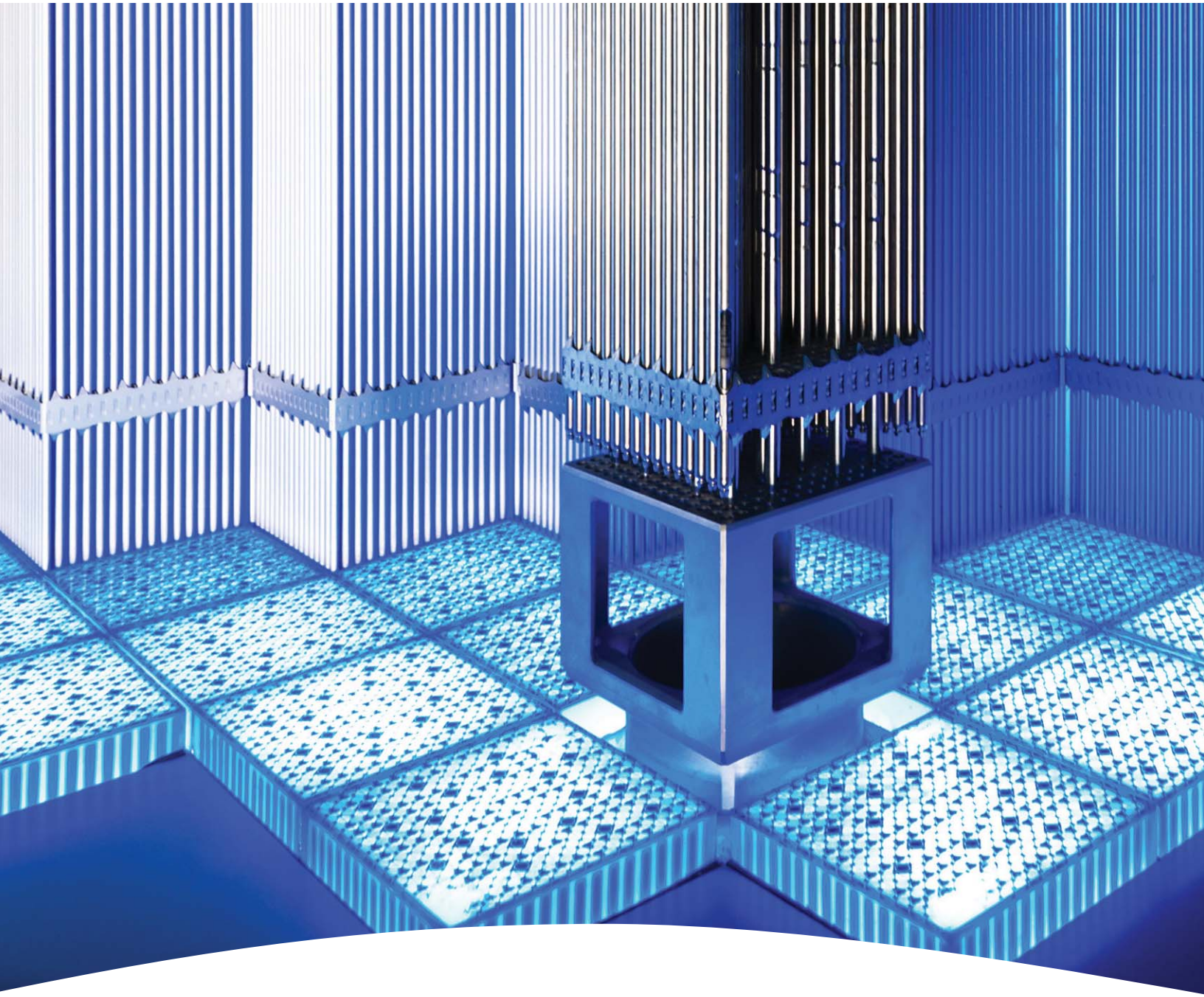
UOP IONSIV™ Ion Exchangers



Efficient treatment of liquid nuclear wastes

UOP
A Honeywell Company

IONSIV Ion Exchangers: A superior nuclear waste remediation product

Even in the most extreme conditions, UOP IONSIV products are proven to exhibit high capacity, selectivity and stability compared to other ion exchange products available today.

UOP IONSIV Ion Exchangers are microporous inorganic crystalline cation exchangers used in the nuclear industry for more than 40 years. These materials provide unique combinations of selectivity, capacity and stability not available from other nuclear waste remediation products today.

UOP offers a portfolio of inorganic ion exchangers including alumino silicates (zeolites) and crystalline silicotitanates to provide our customers with the ability to tailor a solution that will specifically address their needs.

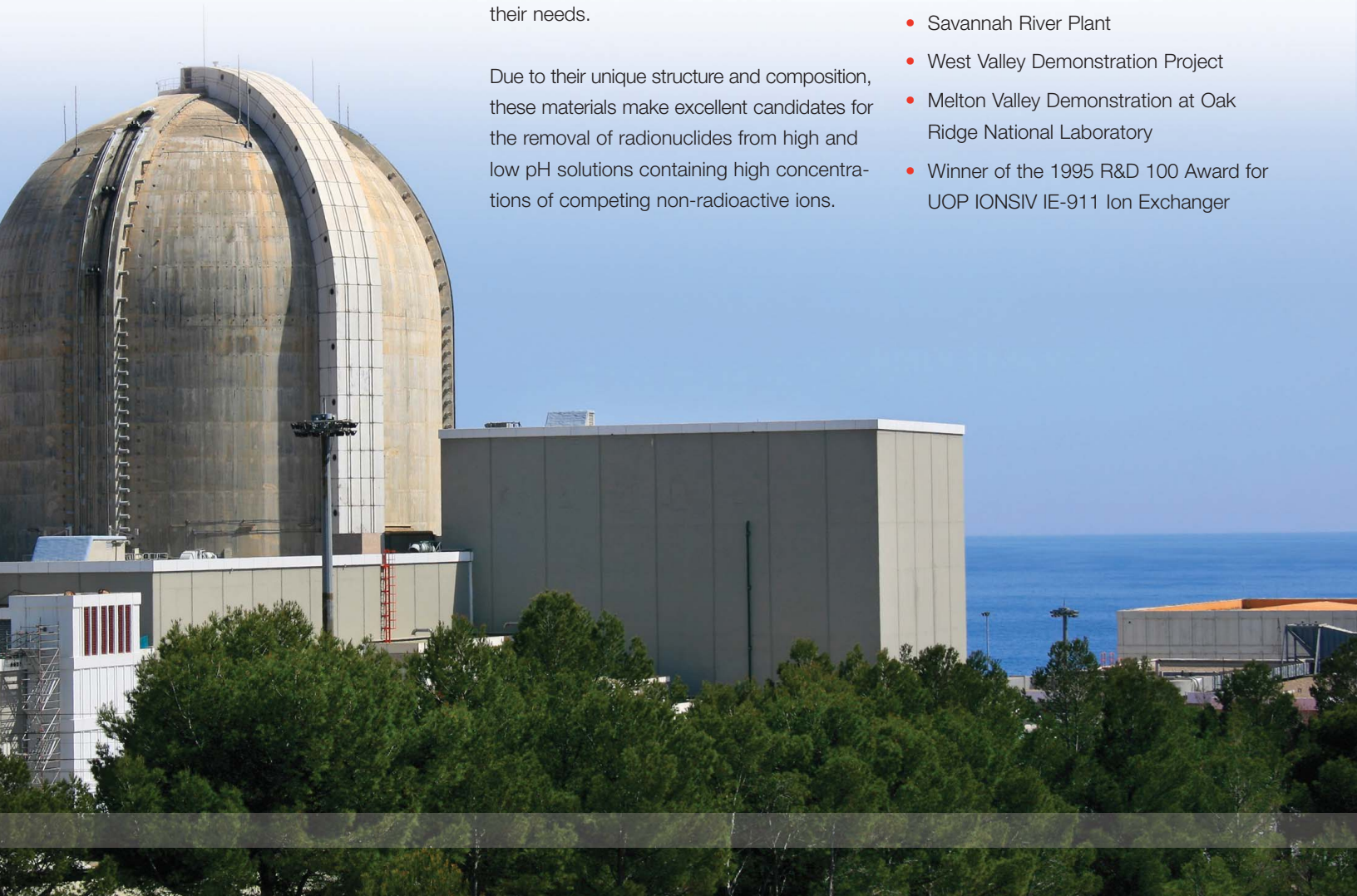
Due to their unique structure and composition, these materials make excellent candidates for the removal of radionuclides from high and low pH solutions containing high concentrations of competing non-radioactive ions.

Typical applications include:

- Removal of Cs and Sr from radwaste streams in commercial power plants
- Removal of Cs and Sr from nuclear reprocessing waste alkaline supernatant
- Removal of Cs from evaporator overheads
- Removal of Cs and Sr from nuclear fuel storage pool water

Proven experience and acclaim

- Fukushima Daiichi
- Three Mile Island
- Savannah River Plant
- West Valley Demonstration Project
- Melton Valley Demonstration at Oak Ridge National Laboratory
- Winner of the 1995 R&D 100 Award for UOP IONSIV IE-911 Ion Exchanger



Superior performance

High cation exchange capacity and selectivity

IONSIV Ion Exchangers commonly exhibit high selectivity and capacity for cation exchange of specific targets, even when high concentrations of competing ions are present. For example, UOP IONSIV IE-911 Ion Exchanger exhibits a significantly higher capacity and shorter contact time for Cs compared with common organic resin and inorganic ion exchangers, as seen in Figure 1.

Each IONSIV Ion Exchanger exhibits a different pattern of ion exchange selectivity. Typical selectivity for exchange of various cations is provided in the Product Portfolio section.

Minimizes final waste forms

IONSIV Ion Exchanger composition is compatible with final waste forms, such as glass and cement. This compatibility, combined with high cation exchange selectivity, minimizes the quantity of final waste form produced.

Single-use media

As a single use media, UOP IONSIV products require no regeneration. This allows for the design of simpler and more economic processes leading to lower costs and higher reliability.

High radiation stability

Excellent retention of ion exchange capacity and superior physical integrity, even in the presence of high levels of ionizing radiation, make IONSIV Ion Exchangers particularly well-suited for the recovery and concentration of radioisotopes for long-term storage. Regeneration of IONSIV Ion Exchangers is typically not required, eliminating secondary waste generation.

Excellent mechanical stability

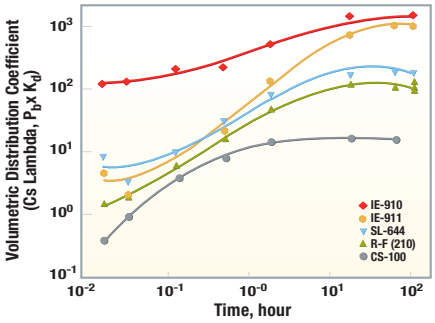
IONSIV Ion Exchangers exhibit no change in volume on contact with waste solutions. Mechanical problems, which can result from swelling, often associated with organic resins, are eliminated. All IONSIV products are formulated with high resistance to attrition and dusting, making them suitable for applications involving slurry transfer of the ion exchanger.

Superior chemical stability

IONSIV Ion Exchangers retain their physical integrity and high ion exchange selectivity over a broad pH range. See Figure 2 for an example of the high Cs distribution coefficient of IE-911 Ion Exchanger over a wide pH range. An IONSIV product can often be matched with the demands of applications even at extremes of pH, as seen in Figure 3, which shows the uptake of Cs on IE-911 Ion Exchanger over time in acidic conditions.

Figure 1

Cs kinetic data in simulant* comparing UOP IONSIV IE-910 series Ion Exchangers with organic resins



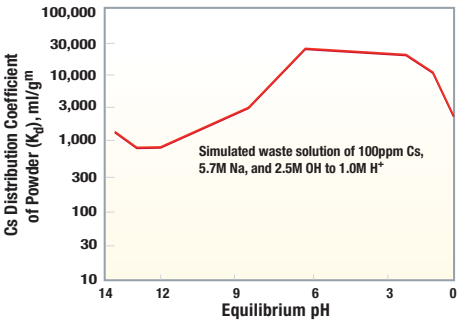
*= 70% 101-AW simulant = 5M Na, $1.0x10^{-4}$ Cs, initial Na/Cs = $5.0x10^4$

CS-100	Commercial phenol-formalde-hyde ion exchange resin
R-F (BSC-210)	Resorcinol-formaldehyde ion exchange resin
Superlig® 644	Macrocyclic ion exchange resin

(Data courtesy Sandia National Laboratories in collaboration with UOP)

Figure 2

Crystalline silicotitanates exhibit high Cs distribution coefficients



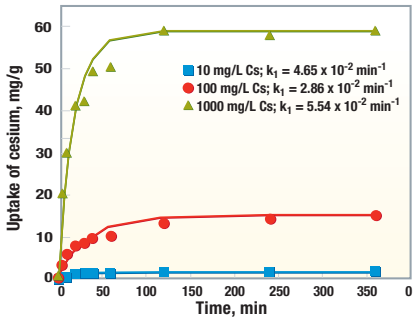
$$K_d = \frac{(C_0 - C_1)}{C_1} \times \frac{V}{M \times F}$$

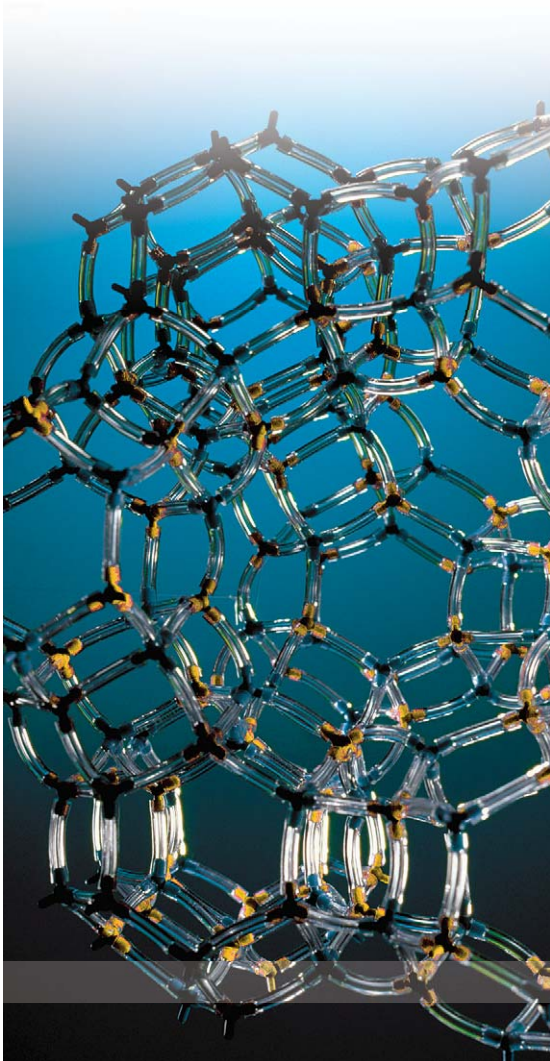
Where: C_0 is the initial counts of the ion of interest in the feed solution before contact. C_1 is the counts after contact; V is the solution volumne in ml, M is the crystalline silicotitanates mass in grams, F is the mass of dry exchanger divided by the mass of wet exchanger.

(Data Courtesy Sandia National Laboratories)

Figure 3

Uptake of Cs on IONSIV IE-911 Ion Exchanger from nitric acid medium (3.0 M) with time





UOP IONSIV Ion Exchangers product portfolio

There are a variety of IONSIV Ion Exchangers to meet your specific requirements. The relative cation selectivity of each product in order of decreasing selectivity is provided below.

IONSIV IE-90 Series

- Zeolites that exhibit a high selectivity for Cs
- Available as beads in two cation forms (IE-95 and IE-96)
- Selectivity:
  Cs > K > Na > Li, Ba > Sr > Ca >Mg

IONSIV A-50 Series

- Zeolites exhibiting high selectivity for Sr
- Available as a powder (A-50) or beads (A-51)
- Selectivity:
  Sr > Ca > Na, Mg > K > Rb > Li > Cs

IONSIV IE-910 Series

- Crystalline silicotitanates that exhibit the highest Cs capacities and selectivities
- Suitable especially for applications at pH extremes (as seen in Figure 2, which shows the Cs uptake over a wide pH range)
- Especially suitable in applications requiring maximum Cs selectivity and capacity as seen in Figure 1
- Crystalline silicotitanates also exhibit excellent Sr selectivity at neutral to alkaline pH and can therefore remove both Cs and Sr simultaneously within these conditions
- Available as a powder (IE-910) or beads (IE-911)
- Selectivity: Cs >> Na

Find out more

If you are interested in learning more, please contact your UOP representative or visit us online at www.uop.com.

UOP LLC, A Honeywell Company
25 East Algonquin Road
Des Plaines, IL 60017-5017, U.S.A.
Tel: +1-847-391-2000
www.uop.com

RESPONSIBLE CARE®
OUR COMMITMENT TO SUSTAINABILITY

UOP5649a
January 2012
Printed in U.S.A.

UOP
A Honeywell Company