

## Form 2

Technology Information	
Area	3 – Removal of radioactive materials from the seawater in the harbor 3. 港湾内の海水の浄化 (1) 海水中の放射性Cs, Sr除去
Title	<b>REMOVAL OF CESIUM AND STRONTIUM BY CO-PRECIPIATION PROCESS</b> 凝集沈殿に因るセシウム及びストロンチウムの除去 (AREVA 3-1)
Submitted by	AREVA

**1. Overview of Technologies****Functions**

The main difficulty for Strontium decontamination in sea water is linked to the important presence of chemical elements (salts) in the effluent to be treated, mainly calcium and magnesium. Because of the presence of these chemical elements the efficiency of chemical treatments will be drastically reduced. As a matter of fact, Sr and Ca belong to the same chemical family (alkaline-earth) and have very similar chemical properties. Selective decontamination of Sr requires therefore the use of a very selective sorbents. Extensive R&D has been carried out to meet this target for several years. Those programs have been intensified around the world following the Fukushima accident in 2011. However, any commercial product (or product at an advanced level of development) able to meet the requested specifications (small quantity of exchanger, compact installation) are yet known. Given the current state of the art, the treatment by precipitation or a co-precipitation seems to be the best available technology. Cs decontamination with ferro-cyanide can be added with a very low impact on process.

Co-precipitation is a well-know process from AREVA. It has been operated for Fukushima effluent treatment in Actiflo-Rad process and is currently operated in effluents treatment units of Marcoule and la Hague.

Moreover, the implementation of such type of process is also perfectly mastered by VEOLIA and SKS (VEOLIA's branch in Japan) as hundreds of industrial installations of such kind have been installed worldwide, including for sea water treatment: Actiflo Rad, Multiflo Rad and Turboflo processes.

Taking into account the activity level, very simple adaptation of equipment for nuclear used will be necessary. The process used is extremely compact, transportable, with a quick set-up and made in Japan for an easy operation and maintenance.

### Summary Descriptive

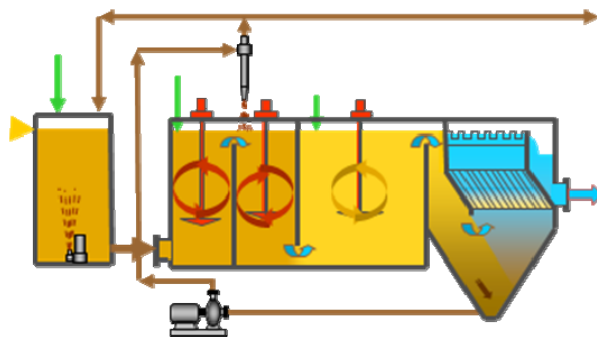
The process is composed on two main technologies :

- Co-precipitation in Actiflo Rad or Multiflo Rad,
- Salted Slurry concentration including a press filter.

### Features & Specifications

#### Actiflo-rad

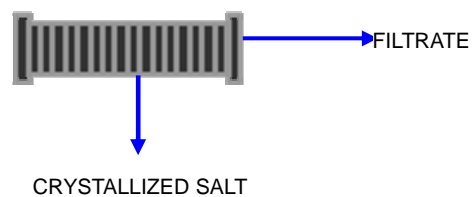
Schematic drawing example:



Size of an Actiflo for 20 to 60 m<sup>3</sup>/hour capacity  
1.3m Width x 3.8m Length x 4.3m Height

#### Salted Slurry Conditioning

Schematic drawing example:



Co-precipitation process with salted slurry recycling has been developed by CEA, AREVA and VEOLIA for Cs and Sr decontamination for increase the kinetic and reduce the salted slurry volume.

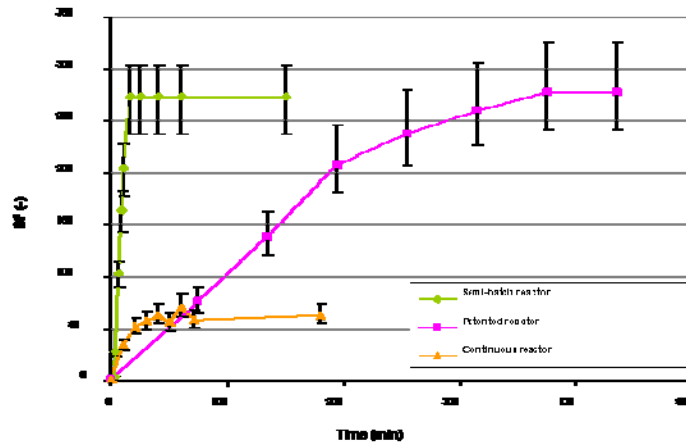
Actiflo / Multiflo units have been optimized for an efficient flocculation and very-high speed decantation (10 to 20 times the speed of a conventional clarifier).



## CEA R&amp;D Lab Scale Tests



## Kinetic studies with sludge recycling



For a decontamination factor between 10 to 100, first assessment of waste production produced by the treatment of 160.000m<sup>3</sup> of sea water (volume of harbor area A) is estimated at around 300m<sup>3</sup>. Taken into account the activity level (very low activity), the solid waste could be store in only sixty "5m<sup>3</sup> steel container".



Pilot unit



Treated water

Pictures of an Actiflo / Multiflo pilot unit in SKS R&D facility in Kawasaki, Japan

### Advantages of our Technology

Other radionuclides could be treated through this process with an adaption of reagents.

### Owner

AREVA & VEOLIA are the owner of the technology.

ATOX may be a partner to help installation and operation on site.

## **2. Notes**

### **Technology readiness level**

Proven technology already in operation for nuclear and industrial water treatment.

### **Challenges / Point to confirm**

- Laboratory tests with contaminated sea water are necessary for optimizing the volume of residual wastes. If required, pilot test could be also performed in order to confirm the main design parameters.

### **Others**

Actiflo Technology is patented with more than 20 valid patents.

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