

Technology for treatment of multi-contaminated radioactive water

Scarab Development AB (Scarab), a Swedish research company located in Stockholm, has developed novel technology which enables separation of multi-contaminated radioactive water into absolutely pure water and sludge.

First lab tests of Scarab technology	feed	permeate
cesium	2.4 Becquerel	Not detected
strontium	2.4 Becquerel	Not detected
radium	2.4 Becquerel	Not detected
plutonium	2.4 Becquerel	Not detected

Tests were made with Lithium Drifted Germanium Detector by the Radiation Physics Department of Lund University in 1992. The detection level was 0.1 Becquerel.

Follow-up studies were ordered by the Swedish Radioactivity Protection Institute and performed in 1996 by the Swedish Government Power Company Vattenfall AB at their Nuclear Power Plant in Ringhals on the West Coast of Sweden. Also these results were below detection levels.

The basis of Scarab's technology is the new unit operation Membrane Distillation (MD) in which hydrophobic membranes are used as barriers for contaminated water while single water molecules pass through in vapor form.

This unit operation uses temperatures below 100°C for the separation process and involves no use of pressure. Contaminants are not collaterally entrained with vapor as in standard thermal separation technologies and they are not unintentionally pressured into or through the membrane as in standard membrane filtration technologies. Consequently, no ions, macromolecules, colloids, bacteria, virus, large particles, nano-particles and other non-volatiles, including radioactive components, can pass.

If volatile components have to be removed, degassing is added. With the combination of MD and degassing all types of contaminants are separated. Conductivity levels of less than 1 µS/cm are achieved in one pass and without pre-treatment or polishing and regardless of feed quality.

Tests with concentrate from desalination plants show that a high concentration factor can be reached which means that the result of the process is absolutely pure water and concentrated sludge.

The first full scale test of Scarab's equipment was done in 2007 in co-operation with Vattenfall AB. The equipment was used for cleaning flue-gas condensate and separation was powered by integration in the cooling circuit of the power plant.

When integrated with a power plant, or with industrial process water, district heating or any other heating or cooling operation, the energy requirements for the process are around 20 kWh heat per ton of permeate plus around 1 kWh electricity per ton. Depending on size of application, the total cost of treatment, including financial costs is calculated to about 2 € per ton of permeate produced.

A new demo was installed by Scarab in Stockholm in March 2012 with a capacity of 200 liters per hour in order to verify the ongoing industrialization process and is now in operation. Large scale manufacture will be ramped up within two years.

Scarab is prepared to share this technology with the Japanese Government and/or with suitable major Japanese companies of excellence, for instance Mitsubishi or Hitachi. As a first step it is proposed that a demonstration unit is tested in Japan.

2014-03-10
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