

# Newsletter

Nº 7 / Diciembre 2020



Con la contribución del programa LIFE de la Unión Europea



LIFE16 ENV/ES/000437

## LAS PLANTAS PILOTO DE LA PROVINCIA DE ALMERÍA DE NUEVO EN MARCHA

Después de permanecer paradas las tres plantas piloto de la provincia de Almería debido al estado de alarma por Covid-19, técnicos de **Diputación de Almería** y **CIESOL** consiguieron reanudar de nuevo la operación de las plantas piloto. Llevando a cabo previamente, operaciones de mantenimiento y limpieza de los filtros. Así como algunas modificaciones de las condiciones de operación .



## FINALIZACIÓN DE LA OPERACIÓN DE LA PLANTA PILOTO DE VIIMSI (ESTONIA)



El pasado mes de septiembre la **planta piloto de Viimsi** finalizó las tareas de operación después de dos años en marcha.

La **Universidad de Tartu** y **Universidad Tecnológica de Tallin** están llevando a cabo el análisis de todos los resultados obtenidos. Un avance de estos resultados:

- eliminación de isótopos de radio entorno al 90%.
- Tasas de acumulación de radionucleidos en los filtros mucho más bajas que en los filtros del sistema que actualmente está operando en la ETAP de Viimsi.

Los principales resultados obtenidos se publicarán en la web del proyecto.

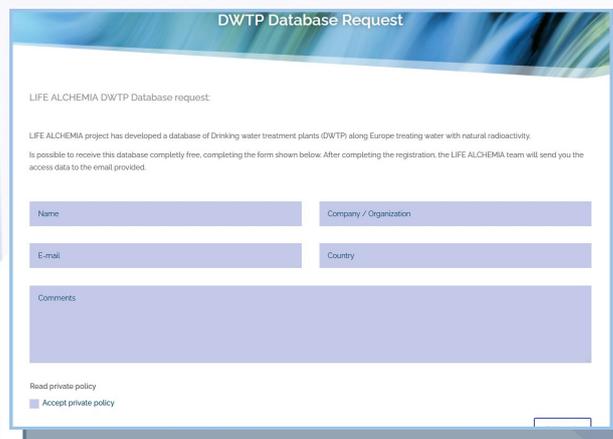
## ACCIONES REALIZADAS

### BASE DE DATOS DE ETAPS EUROPEAS QUE TRATAN AGUA CON RADIATIVIDAD DE CARÁCTER NATURAL

Se está finalizando la actualización de la **base de datos** elaborada en el marco del proyecto.

La base de datos cuenta con información de 12 países europeos.

Para acceder a la base de datos, es necesario **solicitar acceso** al equipo LIFE ALCHEMIA a través de un breve formulario disponible en la página web del proyecto.

A screenshot of a web form titled "DWTP Database Request". The form contains the following fields: "Name", "Company / Organization", "E-mail", and "Country", each with a corresponding input box. Below these is a larger "Comments" text area. At the bottom left, there is a link "Read private policy" and a checkbox labeled "Accept private policy".

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### AMPLIACIÓN DE LA FECHA DE FINALIZACIÓN DEL PROYECTO

EASME ha aceptado una extensión de 9 meses de la fecha de finalización del proyecto, prevista para Diciembre 2020. Siendo la nueva fecha de finalización del proyecto Septiembre 2021.



## IX SIMPOSIO DE INVESTIGACIÓN EN CIENCIAS EXPERIMENTALES

Nuestros compañeros de **CIESOL-UAL** y **Diputación de Almería** participaron en la sesión de posters del IX Simposio de investigación de ciencias experimentales, que se celebró **online** el pasado mes de noviembre.

Se presentaron **dos posters** en la sección dedicada a biotecnología y bioprocesos industriales.

### Removal of iron and uranium in groundwaters through catalytic filter beds of iron oxide and magnesium oxide

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#### Introduction

The LIFE ALCHEMIA project (LIFE16 ENV/ES/000437) faces one of the current challenges in the treatment of water for human consumption, such as the presence of natural radioactivity. This is an environmental problem that cannot be solved at source, since it is generated by the dilution of minerals rich in radioactive isotopes in groundwater, mainly by the Uranium (U), Radium (Ra) and Thorium (Th) decay series. Therefore, new systems capable of providing a sustainable elimination of radioactivity from the point of view of environmental and economic sustainability are needed. The objective of the LIFE ALCHEMIA (LIFE16 ENV/ES/000437) project is to demonstrate the technical and economical viability of sustainable technologies using catalytic filter beds to remove the natural radioactivity in groundwater and thus be able to be used subsequently for urban uses, always ensuring compliance with the legislation in force. The filtering bed materials in pilot plants are manganese oxide coated zeolites, but there are other materials that could be considered (iron oxide and manganese oxide) and which are analyzed in this work.

#### Objective

The objective of this work is the study of the filtering and adsorption process of two different catalytic materials composed of magnesium oxide (80%), CaO (10%) and metal-free elements (10%), the first one, and iron oxide (iron oxide minerals, FeO(OH)) the second one, to reduce natural radioactivity and possible cation interferences in groundwater from two different locations.

#### Materials, methods and tests

Lab-scale discontinuous tests (Table 1) were carried out with iron oxide and magnesium oxide materials, considering two different water locations to be treated. In the case of magnesium oxide, two particle sizes were used (2-5 and 5-8 mm). During the tests, in situ measurements (Image 2) of pH, redox potential, conductivity, turbidity and gamma radiation were carried out. Samples were taken during each test every 0, 5 and 20 minutes, to be able to measure values of cations and anions by ion chromatography, and iron and uranium by ICP-MS.

Particle diameter (mm)	Location	MF tests
5-8	1	6
Magnesium oxide	2	6
2-5	1	3
Iron oxide	2	3
Solid granules (0.5-2)	1	3
	2	3

Table 1. Discontinuous tests.

Image 1. Catalytic material (zeolites coated manganese oxide)

Image 2. Measurement equipments

Image 3. Tests with magnesium oxide material

Image 4. Iron oxide material (A) and magnesium oxide material (B)

#### Results and conclusions

The tests with magnesium oxide materials were carried out with two particle diameters (2-5 mm and 5-8 mm) and two different water extraction points. The best results were obtained with particles of 2-5 mm diameter (Figure 1A) with good percentages of reduction of uranium (74.60%) and iron (96.46%) in location 1 (water rich in anions and cations). The best reduction percentages of uranium (93.15%) were obtained with the magnesium oxide material and the water from location 2 (Figure 1B). It is important to remark that the uranium present in the raw water type 2 (43 mg/L) is higher than in type 1 (13 mg/L). Regarding the results obtained with the iron oxide material, have been satisfactory in water 1 (Figure 2A) with a 39.18 and 94.94% reduction in uranium and iron. For water 2 (Figure 2B), uranium reduction percentages of 50.20% and 75.38% of iron were obtained. The best results for reducing iron and uranium have been obtained with the magnesium oxide material with a particle diameter of 2-5 mm, nevertheless, due to the liberation of magnesium cations, subsequent treatment to reduce the concentration of these ions is needed.

References: Mohamed Soliman Naggar, Abdou Ali Abdou, and Resa Abdel Shattah Ghazala, "Removal of Radium from Uranium Effluent by Manganese Oxide Coated Modified Bentonite," Mediterranean Journal of Chemistry 2018, 7(2), 105-114.

Acknowledgement: This study has been supported by the European Commission, European Project LIFE ALCHEMIA (LIFE16 ENV/ES/000437).

### Chemical regeneration of catalytic filter beds used for the removal of iron, uranium and radium

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#### Introduction

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#### Objective

The aim of this work is to study the reduction of radioactivity and the concentration of iron in the catalytic filter beds in the two tanks, for which a chemical regeneration with KOCl is proposed in both tanks. The specific objectives are: i) reduce the concentration (Bq/kg) of the radioisotopes of U-235, U-238, Ra-226 and Ra-228; ii) reduce the concentration of iron (mg Fe/kg filter) and iii) improve the operation of the pilot plant.

#### Materials and methods tests

Chemical regeneration (Table 1) was carried out in the two tanks of the Tahal pilot plant (1000 kg of filter material in each tank). In tank 1, 639.2 kg of KOCl were added through 11 dosages of KOCl solutions (0.125 and 0.25 kg/L) and backwashing (15 m<sup>3</sup>/h for 15 minutes) at the end of the dosages 9, 10 and 11. Regarding tank 2, the initial accumulated radioactivity in the beds was not as high as in tank 1, therefore 458 kg of KOCl were added in 9 dosages (0.125 and 0.25 kg/L) with counter-current water washes (10 and 14 minutes with 13 and 23 m<sup>3</sup>/h) after the dosages 5 and 6. The residence time of the dosages has been 90 minutes. In addition, gamma radiation was measured throughout the process in both tanks.

DO dosage	Time	U-235	U-238	Ra-226	Ra-228	Fe
1	0	100	100	100	100	100
2	15	95	95	95	95	95
3	30	90	90	90	90	90
4	45	85	85	85	85	85
5	60	80	80	80	80	80
6	75	75	75	75	75	75
7	90	70	70	70	70	70
8	105	65	65	65	65	65
9	120	60	60	60	60	60
10	135	55	55	55	55	55
11	150	50	50	50	50	50
12	165	45	45	45	45	45
13	180	40	40	40	40	40
14	195	35	35	35	35	35
15	210	30	30	30	30	30
16	225	25	25	25	25	25
17	240	20	20	20	20	20
18	255	15	15	15	15	15
19	270	10	10	10	10	10
20	285	5	5	5	5	5
21	300	0	0	0	0	0

Table 1. Dosages of KOCl during the chemical regeneration.

Image 1. Tank 1 during the chemical regeneration process

Image 2. Gamma radiation measurement equipment

#### Results and conclusions

The results of the regeneration process in tank 1 (Figure 2A) have been satisfactory, obtaining removals of 63% and 51% for Ra-226 and Ra-228 and 91% and 27% for U-234 and U-238, respectively. In this tank, gamma radiation was reduced to 0.68 (Figure 2B). Respect to tank 2, the reduction percentages of Ra-226 and Ra-228 were 53% and 56%, respectively. Uranium radioisotopes do not show any reduction due to the very low starting values, very close to the original concentration in the filter materials. Regarding the iron concentration removals, it has been measured in the filter materials, resulting good (52%) in tank 1 (Figure 3A) and unsatisfactory in tank 2 (Figure 3B) where the iron concentration is slightly increased. Finally, gamma radiation is reduced during regeneration. In tank 1 (Figure 4A) from 1.02 to 0.06 µSv/h and in tank 2 (Figure 4B) from 0.3 to 0.15 µSv/h.

The chemical regeneration (KC) applied filling materials composed of zeolites coated by manganese oxide, is an optimal maintenance process for the reduction of the radioisotopes of uranium and radium. It is an economical and simple process.

References: Oud A, Nib-Y, Ruano R, et al. "Regeneration of filter materials contaminated by naturally occurring radioactive compounds in drinking water treatment plant", Water process engineering 2019, 36.

Acknowledgement: This study has been supported by the European Commission, European Project LIFE ALCHEMIA (LIFE16 ENV/ES/000437).

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## PRÓXIMAS ACCIONES

- **ESTUDIOS DE REPLICACIÓN** de la tecnología ALCHEMIA.
- **2º VÍDEO** promocional del proyecto con los principales resultados.
- **MONITORIZACIÓN** de los **INDICADORES** ambientales y del impacto socio-económico del proyecto.
- **4ª REUNIÓN DE MONITORIZACIÓN** con NEEMO.
- **EVENTOS:**

Seminario de las plantas piloto de Almería. Junio 2021. Almería (España)

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