

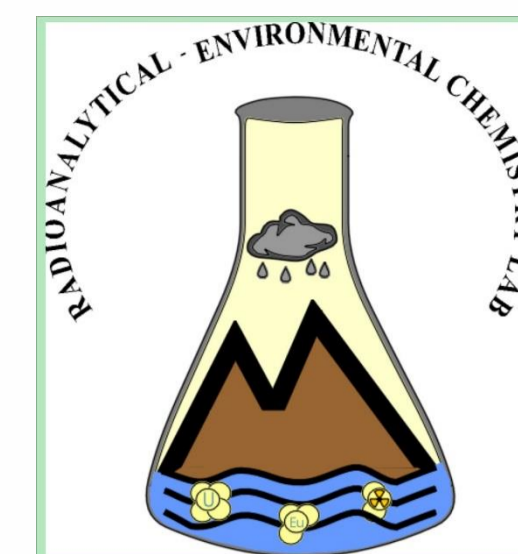


# Uranium desorption from microplastic surfaces

Ioannis Ioannidis<sup>1\*</sup>, Ioannis Anastopoulos<sup>2</sup>, Ioannis Pashalidis<sup>1</sup>

<sup>1</sup>Department of Chemistry, University of Cyprus, P.O. Box 20537, 1678 Nicosia, Cyprus

<sup>2</sup>Department of Agriculture, University of Ioannina, UoI Kostakii Campus, 47040 Arta, Greece



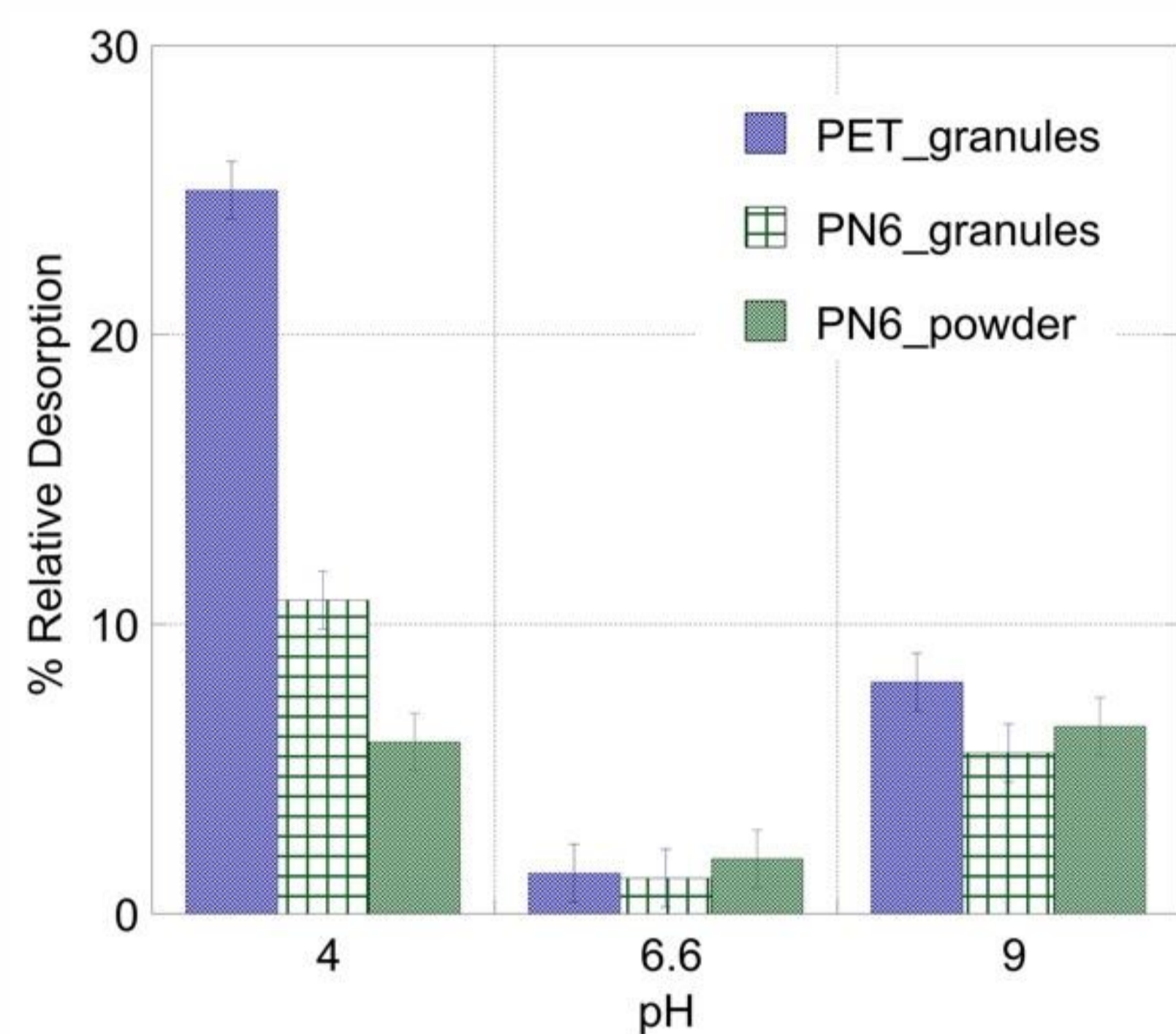
## INTRODUCTION

The release of pollutants including radionuclides from the bulk or surface of microplastics following their ingestion by an aquatic organism is important because of the toxicological effects resulting from the pollutant diffusion into the tissues of the affected organism [1]. Despite the expected toxicity associated from the desorption of toxic pollutants from contaminated plastic material and their subsequent diffusion into biological tissues, there is limited knowledge regarding the toxicological effects of contaminated microplastics on living organisms [2]. Hence, further research studies are needed regarding the desorption of pollutants and from microplastics and their transfer to organisms including the effect the aqueous media composition and other physicochemical parameters such as pH, time temperature. Regarding the interaction of radionuclides with microplastics there are only few studies in the available literature [3-6]. In the present study, the desorption behavior of previously adsorbed U(VI) at ultra-trace levels on microplastics was investigated as a function of pH and using various desorption media such as de-ionized water and EDTA solutions.

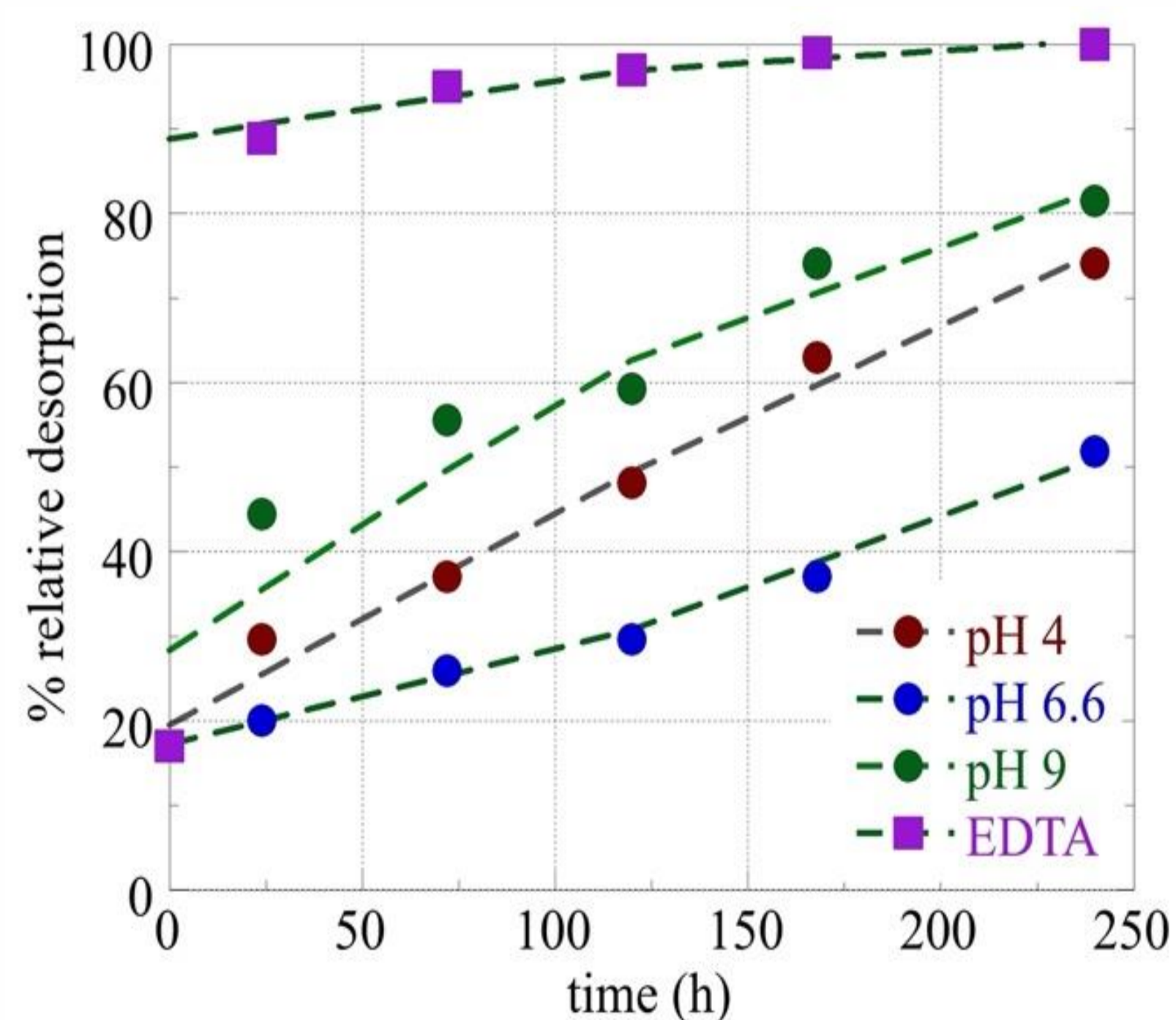
## EXPERIMENTAL

For the desorption experiments, 0.5 g of the studied microplastics (PET and PN6) were added to 20 mL of solution, which contained the U-232 tracer at an initial concentration of 0.5 Bq / mL. The contact time was 30 days and then the solution was decanted and 20 mL of de-ionized water was added. The microplastics were in contact with the de-ionized water for 10 days and following the U-232 activity concentration in solution was determined by alpha spectroscopy to evaluate the amount of U-232 desorbed. The desorption experiments were carried out pH 4, pH 6.6 and pH 9 and the samples were continuously agitated for the whole contact time using a linear shaker. To carry out the U-232 adsorption and desorption experiments from container walls, 20 mL of a U-232 tracer solution with an initial concentration of 0.5 mBq/mL was added to the container and was left to adsorb for 10 days. Then the solution was decanted and replaced with 20 mL of pure de-ionized water and the activity concentration of U-232 desorbed was determined by alpha spectroscopy after 10 days contact time. The experiments were carried out pH 4, pH 6.6 and pH 9, and the procedure was repeated using 20 mL of 0.001 M EDTA solution (pH 4.5).

## RESULTS AND DISCUSSION



Relative desorption efficiency of U(VI) from different microplastics as a function of pH



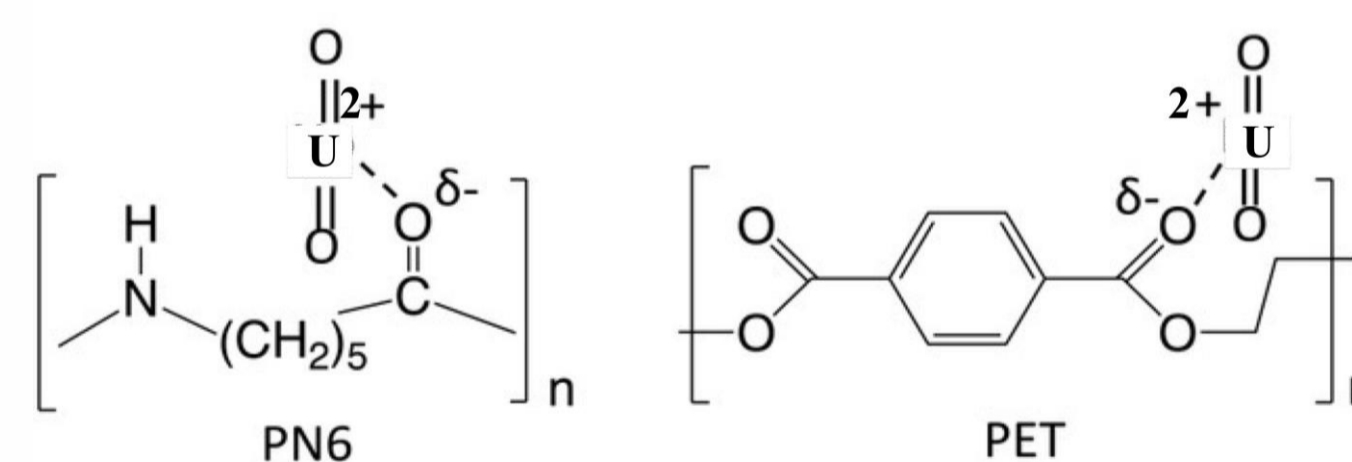
Relative desorption efficiency of U(VI) from polypropylene containers in aqueous solutions as a function of pH and the presence of EDTA (0.001 M) in solution

The amount of U-232 desorbed is:

- highest in the acidic pH region (pH 4)
- decreases to its lowest value in pH 6.6 due to the predominance of neutral species
- increases slightly in alkaline pH region (pH 9) due to carbonate complexation of U(VI)

Relative low desorption efficiency (< 30%):

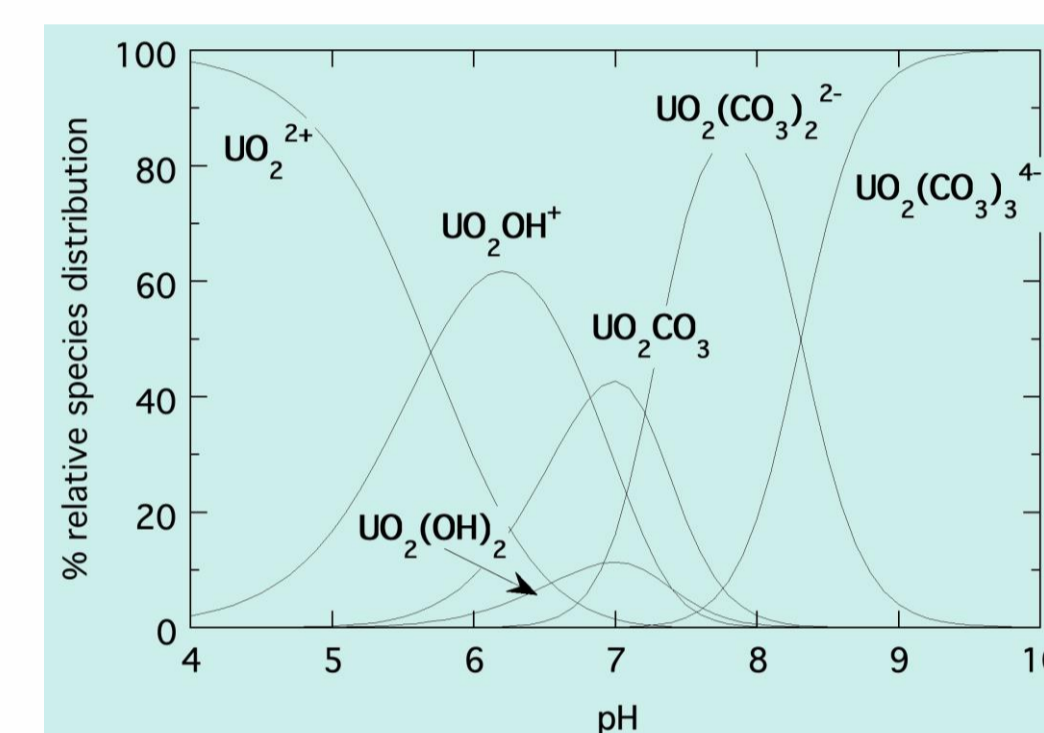
- suggesting relatively strong interactions between the surface moieties and U(VI), which can be attributed to the formation of inner sphere surface complexes



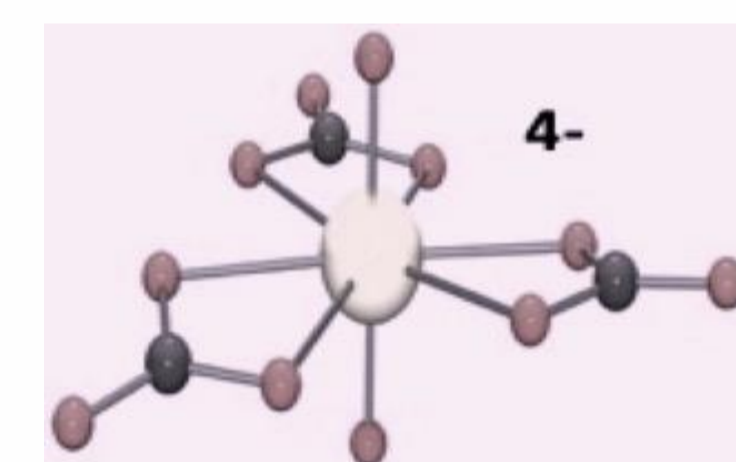
There is a significant impact of:

- the solution pH
- the complexing agent on the desorption efficiency
- the desorption kinetics

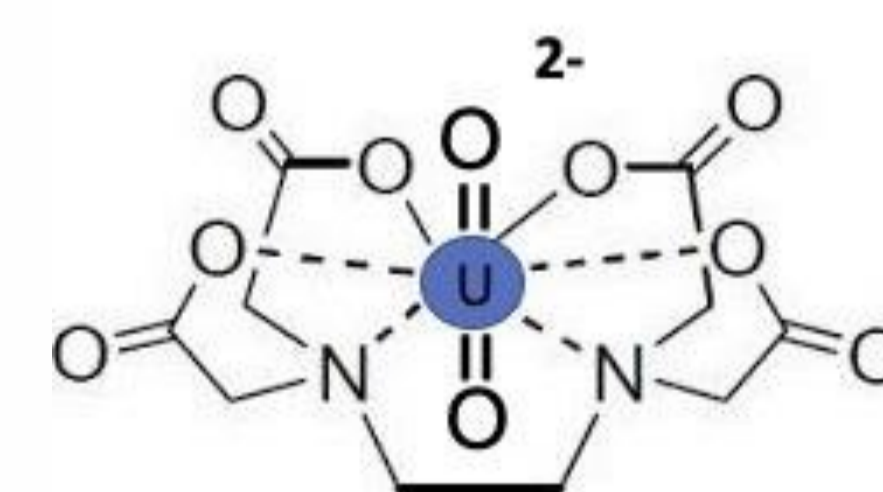
The desorption efficiency after 10 days contact time is 100% for the EDTA



U(VI) species distribution as a function of pH



U(VI)-tricarbonato complex



U(VI)-EDTA complex

## CONCLUSIONS

- Increased desorption efficiencies at high H<sup>+</sup> concentration due to the competitive behavior of H<sup>+</sup> and the in the alkaline pH region due to the formation of U(VI)-carbonato complexes
- The desorption capacity in the presence of complexing ligands increases almost 30%.

## LITERATURE

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- [5] Ioannidis I et. al. (2022) *J Mol Liq* 351:118641
- [6] Ioannidis I et. al. (2022) *J Mol Liq* 356:119056