Radiotracer Gadolinium Pre-Concentration and Detection

Mousumi Singha[1]*, Sangita Pal[2], Subrata Dutta[1], K.N.Hareendran[1], D.Goswami[2], S.B.Roy[1]

[1]Uranium Extraction Division, Bhabha Atomic Research Centre, Mumbai 400085, India
[2] Desalination Division, Bhabha Atomic Research Centre, Mumbai 400085, India,
*E-mail: mousumi.singha@gmail.com

1. Introduction

Radiotracer ^{153}Gd is a low-energy γ-emitter with 8-months half-life, is used as line sources and in calibration phantoms, to ensure that nuclear medicine imaging systems operate correctly and produce useful images of radioisotope distribution inside the patient [1, 2]. The used radiotracer gadolinium is generally disposed as laboratory effluent in different testing experiments. Hence, this toxic radiotracer gadolinium is required to be eliminated from these effluents before disposal to nature. In this paper performance of a "radiotracer gadolinium selective pre-concentrator" viz, polyacrylamide hydroxamate (PHOA) chelator has been studied for removal and recovery of gadolinium.

2. Experiment

2.1. Materials and preparation of simulated gadolinium solution: $Gd(NO_3)_3.6H_2O$ is used as a water-soluble compound to simulate the behavior of radioactive ^{153}Gd. Gadolinium solutions of various concentration have been prepared separately in distilled water and contacted with PHOA resin for 2 h. Loaded gadolinium was eluted with 1M HCl for determining the elution and recovery of gadolinium. Different concentration of gadolinium solutions were analyzed by ICP-AES, ICP-MS and EDXRF.

3. Results and Discussion

Figure 1 shows the uptake of Gadolinium ions (ppm) with varying feed concentration, which increases with feed concentration. The curve indicates a wide and effective sorption range of gadolinium and the steep nature of the graph also indicates its efficiency even for higher feed concentration. Figure 2

indicates concentration of Gadolinium in resin (ppm) and elution efficiency (percentage) with respect to feed concentration variation, that indicates substantial (98% or more) elution efficiency.
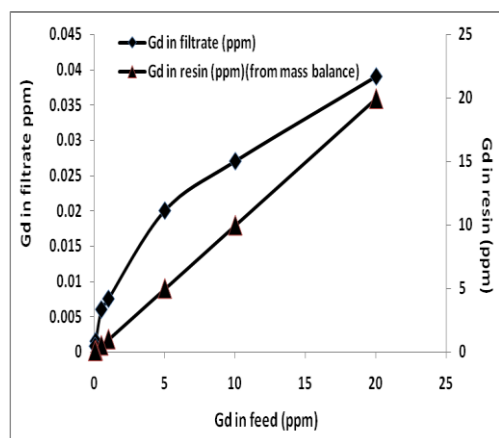

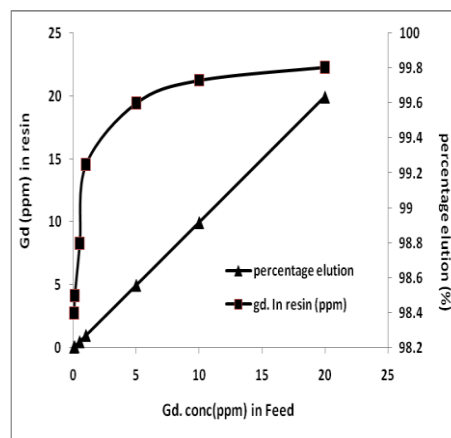Fig 1: Effect of conc. variation of gadolinium

Fig 2: Effect of elution of gadolinium loaded complex

TABLE.1 Gadolinium uptake performance of PHOA during sorption - pre-concentration factor (from mass balance), all concentrations are in ppm

Sl No.	1	2	3	4	5	6
Gd in feed	20	10	5	1	0.5	0.1
Gd in Filtrate	0.039	0.027	0.02	0.0075	0.006	0.0015
Gd in sorbent	19.961	9.973	4.98	0.9925	0.494	0.0985
Preconcentration Factor	0.998	0.997	0.996	0.9925	0.988	0.985

4. Conclusion

The sorption study implies PHOA as an effective matrix for gadolinium has the potentiality as a pre-concentrator for outlet effluents containing radiotracer gadolinium used in MRI and other applications. Contaminated run off or laboratory waste effluents can be safely disposed due to high sorption efficient of matrix (99%). Elution study indicated that gadolinium can be recovered; sorbent matrix can be regenerated and reused as elution factor is 98% - 99%.

References

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