

## Extraction of $^{35}\text{S}$ sulphur from pile-irradiated potassium chloride

### *Introduction*

$^{35}\text{S}$  (half-life 88 days) is widely used as a tracer in agricultural and biochemical studies. It is generally obtained in the carrier-free state by the  $^{35}\text{Cl}(n, p)^{35}\text{S}$  reaction using KCl as the target material.  $^{35}\text{S}$  thus produced is radiochemically contaminated with  $^{32}\text{P}$  (formed by the  $^{35}\text{Cl}(n, \alpha)^{32}\text{P}$  reaction), from which it must be separated.

A number of methods have been reported by different authors<sup>1,2,3</sup> for the separation of  $^{35}\text{S}$  from various targets, *viz.*  $\text{CCl}_4$ , KCl, NaCl,  $\text{FeCl}_3$  etc. In the conventional method<sup>4</sup>, followed in many countries, the pile-irradiated KCl is dissolved in water and the solution passed down a cation-exchange column;  $\text{K}^+$  ions are adsorbed on the column while  $^{32}\text{P}$  and  $^{35}\text{S}$  pass out with the effluent solution as phosphate and sulphate ions.  $^{32}\text{P}$  is then removed either by coprecipitation with  $\text{La}(\text{OH})_3$ , or by passage through a column containing aluminium shavings.

This paper describes a new method for the separation of  $^{35}\text{S}$  from pile-irradiated KCl in which the separation of carrier-free  $^{35}\text{S}$  has been much simplified through the use of an anion-exchange column. The separation of  $^{35}\text{S}$  from  $^{32}\text{P}$  and  $\text{K}^+$  is effected in a single step and  $^{35}\text{S}$  is obtained in a radiochemically pure form. The method has been tried with success for the isolation of millicurie amounts of  $^{35}\text{S}$  and is being adopted for the routine production of this isotope at the Trombay Establishment.

### *Experimental details*

15 g samples of KCl were irradiated with neutrons, in the Apsara reactor, Trombay, at a flux of  $3 \cdot 10^{11}$   $n/\text{cm}^2/\text{sec}$  for about 100 h. The  $^{42}\text{K}$  (half-life 12.4 h) formed by the  $^{41}\text{K}(n, \gamma)^{42}\text{K}$  reaction was allowed to decay before processing. A negligibly small amount of  $^{36}\text{Cl}$  is formed during such a short irradiation.

Measurements of radioactivity were made using an end-window type G.M. counter (window thickness  $2.5 \text{ mg}/\text{cm}^2$ ) in conjunction with a scaling unit.

The irradiated KCl was dissolved in water and made up to a known volume, which served as a stock solution for all the experiments. A suitable aliquot was pipetted out and diluted with an appropriate volume of water, so as to give a solution approximately  $0.1 \text{ M}$  in KCl. A small amount of phosphate carrier (5 mg) is added in order to reduce (i) the adsorption of  $^{32}\text{P}$  on glass, and subsequently (ii) the contamination of  $^{35}\text{S}$  by  $^{32}\text{P}$  during the acid elution. This solution was passed down an anion-exchange column containing the resin Amberlite IRA-400 (40–60 mesh) in the chloride form. The effluent was collected separately and checked for any activity. The column was next washed with 100 ml distilled water and the effluent again checked for activity. A certain amount of  $^{32}\text{P}$  was detected in both these fractions, indicating that it is poorly fixed on the column. Finally the column was eluted with  $0.1 \text{ M}$  HCl and fractions of about 50 ml each were collected separately. The activity in each of these fractions was measured. 0.2 ml from each fraction was deposited on a glass planchet and then evaporated to dryness under an infra-red lamp. They were counted in an

end-window G.M. counting assembly, first without an absorber, then with an aluminium absorber of thickness  $30 \text{ mg/cm}^2$  interposed between the source and the counter window. Such an absorber cuts off all  $\beta$  radiations from  $^{35}\text{S}$  ( $E_{\text{max}} 0.17 \text{ MeV}$ ), so that any contamination due to  $^{32}\text{P}$  ( $E_{\text{max}} 1.7 \text{ MeV}$ ) would easily be detected. It was found that the first two or three fractions (100–150 ml) contained the  $^{32}\text{P}$  free of any  $^{35}\text{S}$ , and that the later fractions contained pure  $^{35}\text{S}$ . A typical elution curve is shown in Fig. 1. The curve shows two distinct peaks with good resolution, which indicates the possibility of separating radiochemically pure, carrier-free  $^{35}\text{S}$  from irradiated KCl using an anion exchanger.

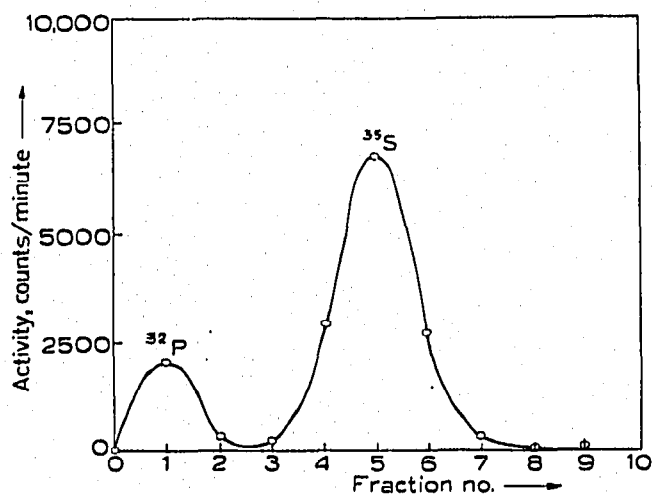


Fig. 1. Elution curve with 0.1 N HCl.

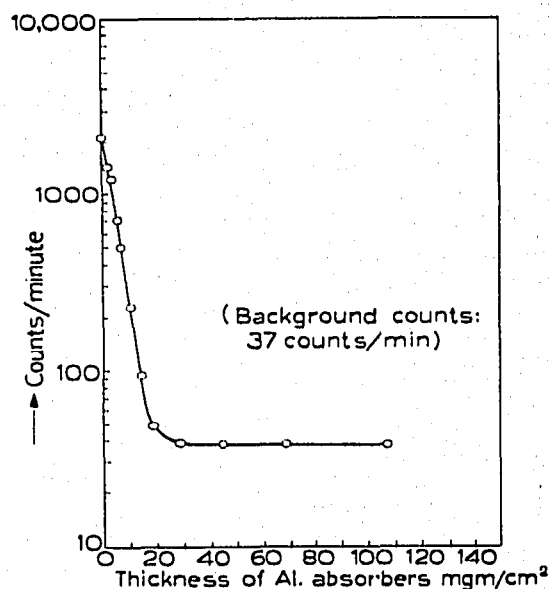


Fig. 2. Aluminium absorption curve of the final  $^{35}\text{S}$  solution.

The recovery of  $^{35}\text{S}$  has been found to be almost quantitative. The column was checked for any residual activity on it by elution with concentrated HCl. No activity was detected in the effluent solution.

#### Radiochemical purity

In Fig. 2 is shown the aluminium absorption curve taken on an aliquot from a mixture of all the fractions containing pure  $^{35}\text{S}$ . It is evident that the  $^{35}\text{S}$  obtained is radiochemically pure.

#### Acknowledgements

My thanks are due to Dr. V. K. IYA and Mr. C. TAYLOR for their suggestions.

Isotope Division, Atomic Energy Establishment, Trombay,  
Bombay (India)

R. G. DESHPANDE

<sup>1</sup> O. ERBACHER AND H. V. LAUE-LEMCKE, *Z. anorg. Chem.*, 259 (1949) 249.

<sup>2</sup> M. B. WILK, *Can. J. Research*, 27 B (1949) 475.

<sup>3</sup> M. CHEMLA AND P. SUE, *Compt. rend.*, 233 (1951) 247.

<sup>4</sup> A. F. RUPP AND F. T. BINFORD, *J. Appl. Phys.*, 24 (1953) 1069.

Received September 24th, 1958