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# Recovery of Technetium$^{99}$ from Laboratory Wastes

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## Introduction

Technetium chemistry is commonly studied in many chemical laboratories in many parts of the world. The growing interest in studying its chemical behaviour is attributed to the fact that its metastable isomer technetium$^{99m}$ is the principal radiodiagnostic used in Nuclear Medicine. The inorganic chemistry data deduced from technetium$^{99}$ studies can be useful in producing new and more selective radiopharmaceuticals labelled with $^{99m}$Tc [1–3].

The recovery of technetium from solution wastes, produced in chemical laboratories, is critical in order to resolve the pressing problem of storing this radioactive material.

The precipitation of pertechnetate as the tetraphenylarsonium salt is already known [4, 5] and is one of the methods for the gravimetric determinations of technetium$^{99}$. Nevertheless the methodology for recovering technetium as $[AsPh_4]TcO_4$ from laboratory residuals has not been well studied.

## Experimental

A mixture of technetium complexes in different oxidation states (containing some ligands as used in our laboratories and dissolved in common organic solvents) was used as a standard to determine the optimum yield from the method.

$TcCl_3(PMe_2Ph)_3$ (80 mg), $TcBr(CO)_3(PMe_2Ph)_2$ (90 mg), $(NH_4)_2TcCl_6$ (63 mg), $TcI_2P(OEt)_2Ph_4$ (42 mg), $(NH_4)_2TcBr_6$ (110 mg), $(NH_4)_2TcI_6$ (32 mg) were dissolved in 100 ml of a mixture containing in equivalent amounts, ethanol, acetone, dichloromethane, diethylether, glyoxal and acetonitrile. The sample so obtained was refluxed for two hours and then the solvent was distilled to leave a small volume. The residue was treated with $H_2O_2$ 30 vol (20 cm$^3$) and boiled for 5–6 hours. The solution became concentrated on distillation and so further additions of $H_2O_2$ were made.

On cooling two layers were formed: an aqueous solution and an organic mixture. The aqueous layer was collected and treated with a saturated solution of $[AsPh_4]Cl$ (500 mg in $H_2O$) to give a white precipitate of $[AsPh_4]TcO_4$ which was filtered, dried and by weighing gave a yield of 95% of technetium on respect to the starting amount.

The solid was characterized by IR spectroscopy ($\nu$(Tc=O) = 895 cm$^{-1}$, $\nu_{AsPh_4}$ = 1086, 470, 451, 342, 333 cm$^{-1}$) and was found to be pure.

The above procedure was applied to the liquid residues from our laboratories. The liquid wastes were concentrated to small volume and the volume was measured ($V_o$). 50 $\mu$l of this solution was drawn to determine the activity. The treatment with $H_2O_2$ was carried out and, for the sake of determining the yield of pertechnetate formation, samples of 50 $\mu$l were drawn from time to time, both from the organic phase and from the aqueous solution taken back to the starting volume ($V_o$). The radioactive determination of the previous samples, performed by a method reported elsewhere [5], allowed us to conclude that the best yield was 80–85% of technetium$^{99}$ in aqueous solution and 13–16% in the organic phase. In the distilled solution technetium is present only in trace amounts. From this point the procedure was the same for the prepared standards.

## Conclusions

Pertechnetate precipitation with $[AsPh_4]Cl$ is nearly quantitative. The cation $[AsPh_4]^+$ forms insoluble salts with perchlorate, nitrate, sulfate, iodide *etc.* Nevertheless some of these salts can be oxidized by treating with $H_2O_2$ and have chemical properties completely diferrent from pertechnetate. These impurities can be eliminated when using pertechnetate for the production of the complexes.

Using the $[AsPh_4]TcO_4$ compound, recovered with the method described above, the complexes $[AsPh_4]_2TcCl_6$, $[AsPh_4]TcOCl_4$, $TcCl_4(PPh_3)_2$, $TcCl_3(PMe_2Ph)_3$ *etc.*, have been prepared.

Therefore the method allows us to recover and use technetium$^{99}$ with a high yield, so reducing to the lowest amount the storage of radioactive wastes of this long-life $\beta$-emitter.

## References

1 R. L. Hayes, in 'The Chemistry of Radiopharmaceuticals' Masson, New York, 1978, pp. 155–168.
2 U. Mazzi and E. Roncari, III Convegno su Radiochim. Chim. Nucl., Radiaz. e Radioel. Padova 12–14 maggio, 1980.
3 G. Bandoli, U. Mazzi, E. Roncari and E. Deutsch, *Coord. Chem. Rev.*, submitted for publication.
4 R. Colton in 'The Chemistry of Rhenium and Technetium' Interscience Publ. London, 1965, pp. 26–27.
5 G. A. Mazzocchin, U. Mazzi, R. Portanova and O. Traverso, *J. Inorg. Nucl. Chem.*, *36*, 3783 (1974).

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