This paper describes the brief history of forensic activation analysis in Australia, together with a description of techniques and equipment employed. Forensic activation analysis began in 1967 and since that time, many cases have been handled; these include arsenic determinations in hair, glass, metal, hair and drug comparisons together with gunshot residue determinations from the hands of suspects. The paper discusses irradiation facilities and equipment available for providing an activation analysis to police forces throughout Australia and the types of analyses carried out, and the reception of these analyses in Australian Law Courts.

Introduction

Forensic activation analysis in Australia began as a specific discipline in 1967 with the appointment of the first full time specialist forensic analyst. Prior to this date cases of special importance were analysed by chemists of the Australian Atomic Energy Commission.

A section was created within the framework of the Commonwealth Police Force, known as the "Neutron Activation Analysis Section". To this section, a graduate chemist was appointed and he entered the force with the rank of Inspector First Class.

Since its inception, the post has been occupied by two chemists, Mr. R. Caldwell held the position until December 1970 and the author was appointed as his replacement in April 1971.

Duties of the Forensic Activation Analyst

The duties are twofold, those of analysis of samples of forensic importance and of education of Law Enforcement Bodies.

Primarily the analyst is concerned with the evaluation, by neutron activation analysis, of any samples of forensic interest. These samples have so far included:
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Hair, marihuana, paint chips, copper wire, glass, soil and gunshot residues. Samples are submitted by any official Law Enforcement Organization in Australia or any nearby country, the decision on whether the sample is appropriate for NAA being left entirely to the analyst.

Samples have reached this department from the police forces from every State in Australia as well as samples from New Zealand, New Guinea and Fiji.

In addition to sample analysis, Court appearances are demanded on specific occasions and Lectures on Neutron Activation Analysis are delivered, on a regular basis, to official law enforcement schools throughout Australia.

Facilities available

The Australian Atomic Energy Commission has made available its NAA facilities which are listed below.

Irradiation facilities

The major thermal neutron source available at the Commission's research establishment at Lucas Heights, Sidney is a research reactor known as H.I.F.A.R. (High Flux Australian Reactor). This reactor is one of the D.I.D.O. type and operates at a powder output of 10-11 MW.

Samples to be activated are pneumatically injected into various positions within the shielding of the core by means of self service irradiation ports.

Facility No. X-6: This consists of ten tubes located in the graphite reflector - five have a nominal thermal neutron flux of $5 \times 10^{12} \text{ n cm}^{-2} \text{ sec}^{-1}$ and the remaining five have a flux of $2 \times 10^{12} \text{ n cm}^{-2} \text{ sec}^{-1}$.

Rabbits for this facility are made of either pure aluminium or polypropylene and measure 2.6 cm diameter by 6.2 cm length.

Facility No. X-84: This is a higher flux neutron self service irradiation tube which extends through the graphite shield and just protrudes into the reactor aluminium tank which contains the D$_2$O moderator/coolant for the pile. The flux in this tube is approximately $3 \times 10^{13} \text{ n cm}^{-2} \text{ sec}^{-1}$ plus a small percentage of epithermal neutrons - the rabbit size for this port is 1.6 cm diam. by 4.9 cm length.

Facility No. X-10: At the time of writing this is still being completed - it is a high flux, fast access, self service facility with a sample transit time of 2-5 sec in either direction from the sending/receiving station.

This station is located just outside the reactor shell and houses the counting equipment as well, in order to minimise decay time for irradiated samples.

The irradiation position is similar to that of X-34 and hence has the same nominal flux available. Rabbits for this tube are made of polypropylene and measure 3.9 cm diameter by 9.2 cm length.