gleichsweise wurden aber auch einige Proben mit höherer Schichtdicke gemessen, die nach der entsprechenden Korrektur gut mit den vorhergehenden Messungen übereinstimmten.

Wir möchten nicht versäumen, unseren herzlichen Dank Herrn Dr. D. M. GRUEN (Argonne Nat. Lab. USA), unter dessen Betreuung der erste Teil der Arbeit durchgeführt werden konnte, auszusprechen.

Activation Analysis of the Dutch 50 c. Stamp of 1867

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With 3 figures. (Received September 20, 1963)

Summary Good and bad samples of this stamp, whose price changes considerably with the colour variation, were activated in a neutron flux and the resulting activity analyzed. One day after a short irradiation the main activity is due to copper. The copper content is related to the quality of the colour and this permits an evaluation of this stamp by activation analysis.

Zusammenfassung Gute und schlechte Exemplare dieser Marke, deren Preis stark vom Farbton abhängt, wurden mit Neutronen aktiviert, und die entstandene Aktivität wurde analysiert. Einen Tag nach einer Kurzbestrahlung stammt die Aktivität hauptsächlich von Kupfer. Der Kupfergehalt hängt wiederum mit der Farbqualität zusammen, so daß der Wert der Marke durch Aktivierungsanalyse bestimmbar ist.

Résumé Le prix de ce timbre-poste varie fortement avec sa couleur. Nous en avons irradié aux neutrons des spécimens bons et mauvais, et analysé l'activité produite. Un jour après une courte irradiation l'activité principale est due au cuivre. Puisque la teneur en cuivre est liée à la qualité de la couleur, l'analyse par activation permet d'évaluer ce timbre-poste.

Introduction

The 50 c. stamp of the dutch series of 1867 (N° 12 in the dutch N.V.P.H. catalogue) has a "gold" colour, which fades easily and for this reason the value of this stamp is highly dependant on the quality of the colour. Since at that time aniline dye colours had not yet been introduced in dutch stamps, we thought it would be worthwhile to investigate the colour differences by neutron activation analyses.

Experimental

Two samples, 1 and 2, with the high quality colour and one, sample 3, which was very badly "rusted" were washed with distilled water and dried. They were irradiated together for one hour in the argentine RA 1 reactor with a mean flux of roughly $5 \cdot 10^{11}\ n/\mathrm{cm}^2 \cdot \mathrm{s}$. The stamps were mounted on aluminium trays and covered with cellophane, carefully conserving the same geometry. Countings were made with a GM counter of 2 mg/cm² and with a sliding channel scintillation counter with a $1^1/_2'' \times 1^1/_2''$ NaI crystal.

Results

Countings were started one day after the irradiation. Decay curves for all three samples taken with a 272 mg/cm² aluminium absorber are represented in Fig. 1 and showed half-lives of about 15 hours, the activity of sample 3 being much lower than that of the other two. The gamma spectrum of sample 1 was taken one day after irradiation through a 1 mm Al absorber with a 1 volt channel width, and is shown in Fig. 2. One strong gamma peak is observed corresponding to 510 keV. Gamma activities at higher energies were not appreciable. The 510 keV peak decreased with a 13 h. half-life. An absorption curve of sample 2 taken with the GM counter and aluminium absorbers 3 days after irradiation is shown in Fig. 3. The main beta component is soft having a maximum energy of about 600 keV.

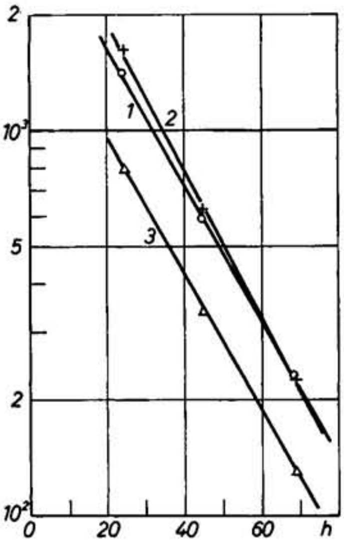

Fig. 1. Decay curves taken through 272 mg/cm² Al

An intercomparison of all three samples was made three days after the irradiation using the GM counter and the scintillation counter set at the 510 keV gamma peak. The results are shown in Table 1 were all values have been normalized taking sample 2 as unit.

It can be seen from these results that the main activity of the samples, once the short-lived activities have decayed, is mainly due to ^{64}Cu which has a half-life of 12.8 h. and decays both by positrons and negatrons

Table 1. *Comparison of the activities of the three samples, taken three days after irradiation*

	Scint. counter	GM Counter	
Sample	510 keV	no absorption	272 mg/cm²
1	0.91	0.86	0.93
2	1	1	1
3	0.26	0.25	0.56

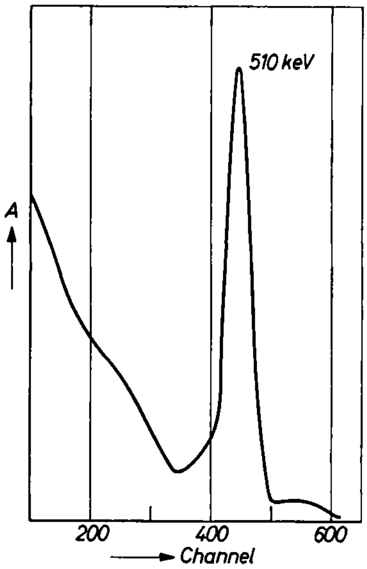

Fig. 2. γ-Spectrum of sample 1 one day after irradiation

(maximum energies: 570 keV and 657 keV respectively). ^{64}Cu is one of the few positron emitters formed by neutron capture of a stable nuclide and can therefore easily be identified by the 510 keV gamma ray. Table 1 shows that if the copper activity is measured by beta counting, the best results are obtained with the soft part of the spectrum. Sodium may be the interference at higher energies.

The neutron flux had not been constant during the irradiation and therefore the copper content of the samples cannot be known accurately. However from the estimated mean flux, the counting efficiency and the measured activity, it follows that the copper content of sample 1 amounts to about a milligram. The discoloured stamp, sample 3, has $^1/_4$th this content.

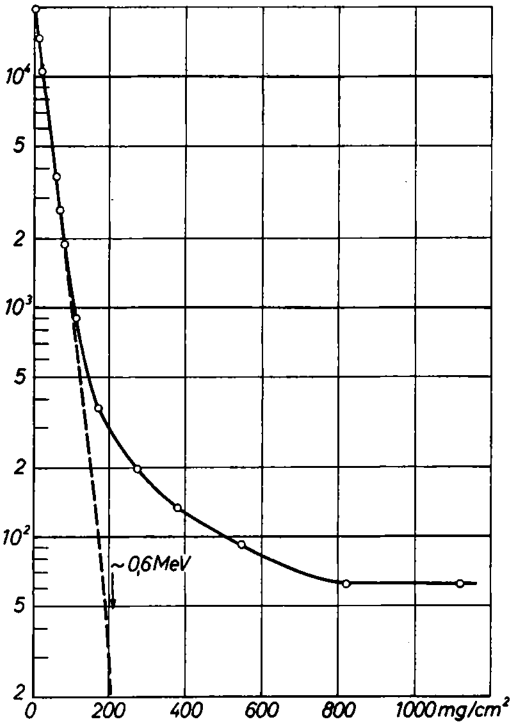

Fig. 3. Absorption curve of sample 2 three days after irradiation

Conclusions

Activation analysis of the 50 c. dutch stamp of the 1867 series shows that copper plays a principal part in the "gold" colouring. The quality of the colour depends on the copper content and activation analysis, which is non-destructive, can be used as a very sensitive test to evaluate this stamp.

Aktivierungsanalytische Bestimmung von Lithium mit Hilfe der Reaktionskette $^6Li(n, \alpha)^3H$ und $^{16}O(t, n)^{18}F$

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Herrn Prof. Otto Hahn *zum 85. Geburtstag in Verehrung gewidmet.*

Mit 3 Abbildungen. (Eingegangen am 15. April 1964)

Zusammenfassung Mit Hilfe der Reaktionskette $^6Li\ (n, \alpha)\ ^3H$ und $^{16}O\ (t, n)\ ^{18}F$ wurde eine aktivierungsanalytische Bestimmung von Lithium ausgearbeitet, deren Erfassungsgrenze bei 0,01–0,02 ppm ($10^{13} n$/sec cm²) liegt. Es wird eine Übersicht über die bei Bestrahlung im Reaktor möglichen Störreaktionen gegeben. Das Verfahren erfordert die Anwesenheit von Sauerstoff. Es werden die Möglichkeiten für die Behandlung auch sauerstofffreier Substanzen mitgeteilt. Ferner wird gezeigt, daß der Matrixeffekt, der auf die verschiedene Reichweite der Tritonen in verschiedenen Proben und auf deren unterschiedliche Sauerstoffkonzentration zurückzuführen ist, und Standards von gleicher Zusammensetzung wie die Probe erfordern würde, rechnerisch ausgeglichen werden kann. Es werden Analysenvorschriften und die Ergebnisse zahlreicher Beleganalysen angegeben.