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THE MAGNESIUM-28-ALUMINUM-28 SYSTEM: AN ALUMINUM-28 GENERATOR

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Of the known aluminum isotopes, one, Al^{26g} , has a very long half-life, but is difficult to prepare in reasonable quantities, two, Al^{28} and Al^{29} , have very short half-lives, 2.30 m and 6.6 m respectively, almost too short to use in tracer experiments, and the rest have half-lives of the order of a few seconds or less. For experiments where integrated energy absorption is an important factor, e. g. physiological experiments, Al^{28} or Al^{29} would be more suitable than Al^{26g} .

Al^{28} and Al^{29} may be prepared directly by means of a number of nuclear reactions; for example, $\text{Al}^{27}(\text{n},\gamma)\text{Al}^{28}$, $\text{Al}^{27}(\text{t},\text{p})\text{Al}^{29}$, $\text{Si}^{28}(\text{n},\text{p})\text{Al}^{28}$, $\text{Si}^{29}(\text{n},\text{p})\text{Al}^{29}$, etc. All of these methods, however, suffer at least one drawback. They all require an extremely fast method of purification of the newly formed isotope and subsequent fast incorporation in the medium under study. The difficulty alone in handling freshly irradiated materials and in separating the desired activity from side products need not be emphasized further. Far superior to direct preparation is a method of milking the desired isotope from a longer lived precursor. This can be done with Al^{28} .

Mg^{28} decays with a 21 h half-life to Al^{28} . It is readily available from the $\text{Mg}^{26}(\text{t},\text{p})\text{Mg}^{28}$ reaction and can be obtained commercially⁽¹⁾. The commercial material, prepared by irradiation of a $\text{Li}^6\text{Mg}^{26}$ alloy in the Brookhaven Graphite Research Reactor, and purified by a combination of hydroxide precipitation and ion exchange through Dowex-1 and alumina, was still

*This work was performed under the auspices of the U. S. Atomic Energy Commission.

found to contain a small amount of impurity, identified as Cd^{115} and Cu^{64} . These were removed by sulfide precipitations in the presence of Cd and Cu carriers. The Mg^{28} solution was then placed on a Dowex 50W column in the Na^+ form and washed with 200 ml of 1 N NaOH. This removed additional unidentified impurities.

The column, Fig. 1, as prepared above, now serves as a generator for Al^{28} of exceptional purity. The Al^{28} is eluted in 10-30 seconds, giving a 30% yield, by means of a 1 N NaOH solution containing 0.5 mg/ml of carrier aluminum. The column may be eluted repetitively, after allowing a few minutes between elutions for Al^{28} to grow back in. Al^{28} has the shortest half-life of any nuclide for which a useful generator has been developed.

The advent of exceptionally pure Mg^{28} and Al^{28} made it possible to determine their half-lives apparently more accurately than heretofore. After Al^{28} had grown into equilibrium, the Mg^{28} was counted for about fourteen half-lives in a well-type gamma scintillation counter and with an end window beta-proportional counter. The Al^{28} was counted for over three half-lives with both a 76 x 76 mm NaI(Tl) gamma scintillation counter and with a plastic beta-scintillation counter, both coupled to a TMC-402 analyzer operated in the multiscaler mode. The data was analyzed by means of the least squares method. The impurities in the samples were found to be present in less than .01% for the Mg^{28} and less than .1% for the Al^{28} . The results are tabulated in Table 1.

TABLE 1

HALF-LIVES

<u>Nuclide</u>	<u>No. of Determinations</u>	<u>Half-Life</u>	<u>Other Values (References)</u>
Mg^{28}	20	$20.88 \pm .06 \text{ h}$	$20.8 - 21.8 \text{ h}^{(2)}$
Al^{28}	16	$2.238 \pm .006 \text{ m}$	$2.305 \pm .006 \text{ m}^{(3)}$ $2.31 \pm .01 \text{ m}^{(4)}$

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FIG.1 ALUMINUM - 28 GENERATOR