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C 14

ADDRESS REPLY TO:
DISTRICT ENGINEER
MANHATTAN DISTRICT
CORPS OF ENGINEERS
P. O. BOX "E"
OAK RIDGE, TENNESSEE

REFER TO FILE NO.

WAR DEPARTMENT
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
MANHATTAN DISTRICT
OAK RIDGE, TENNESSEE

AEC.

EIDMK-6

18 September 1946.

Subject: C 14 Information.

MEMORANDUM to Those Interested in the Use of C 14,

As announced in Science, June 14, 1946, and numerous other scientific journals, more than fifty radioactive isotopes are now being produced by the uranium pile through neutron irradiation and fission processes for national distribution by the Manhattan Project. The chief purpose of this program is to encourage fundamental research in fields of medicine, biology, chemistry, physics and other sciences. Probably the most important of the available radioisotopes is radiocarbon of mass 14 (C 14). Carbon 14 has been and is continuing to be a valuable scientific tool particularly for investigations in the fields of medicine, biology and organic chemistry.

C 14 is now available from the Manhattan Project in the form of barium carbonate with 3-6% of its carbon content as the isotope C-14. An activity of 1 mc of C 14 will be contained generally in less than 0.2 gram of barium carbonate. The obvious method of incorporating C 14 from this source into suitable organic starting materials, is through carbon dioxide. As an aid to those investigators who are contemplating use of or who are using C 14 in research programs, this memorandum has been compiled.

Interchange and Dissemination of Information on Use of C 14.

Since there is now a sudden and great increase in the number of workers using C 14 and in the quantities available, and since there are many problems common to all users of C 14, this office feels that there is an urgent need for rapid interchange of information relative to the preparation of C 14 for use in investigations, measurement technique and availability of prepared labeled materials at various laboratories.

Inclosed with this letter is a list giving successful applicants for C 14. their addresses, and their proposed research problems. It is hoped that interested individuals will freely communicate with other investigators given on the above list to help promote mutual progress in the use of C 14.

This office is willing to become the focal point for available information; that is, we are prepared to collect and disseminate the in-

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formation which will be directly applicable to the problems of C 14 utility.

For example, there is also inclosed with this communication (1) a paper by Warwick Sakami, William E. Evans, and Samuel Gurin entitled "Methods of Synthesis of Organic Compound Labeled with C 13" and (2) a bibliography prepared by the Isotopes Branch of references on (a) some organic compounds prepared from CO_2; (b) a survey of synthetic work in which C^{11}, C^{13}, and C^{14} have been utilized. (An arbitrary limit has been set upon the scope of this compilation, and it should not be inferred that this list is intended to be an exhaustive and complete literature survey of this field.)

These serve as an illustration of information which may be referred to this office for dissemination without the usual long delay which frequently accompanies publication.

As a note to the methods describe in the paper by Sakami and others, it might be well to add that the quantity of materials handled in this paper are roughly 100 times that which would be handled in processing 1 mc of C 14 as barium carbonate to organic derivatives. However, this paper may have much value by suggesting possible means of approach to this problem.

Health-Safety with C 14.

It is proper to include a note or two on the toxicity of C 14. Calculations will show that a man of 60 kg body weight will have to absorb and retain 1.8 mc of C 14 distributed uniformly throughout his body in order to obtain a dose of radiation equivalent to 0.1 roentgens per day. This means that an individual would have to absorb and retain by inhalation, by ingestion or by absorption through breaks (cuts, abrasions, etc.) in the body surface approximately 250 mgm of barium carbonate containing around 3% of its C atoms as C 14 (or its equivalent as radioactive CO_2). Ruling out freak accidents, careful laboratory procedures would prevent practically all possible health hazards involved in using millicurie quantities of C 14.

The worst condition for the intake of C 14 that one can logically assume is the breathing of C 14 labeled carbon particles which would deposit and remain in the lungs. In such a case, Dr. K. Z. Morgan has calculated that 32 microcuries in the lungs results in 0.1 r.e.p. (roentgens equivalent physical) per day. For continuous exposure Dr. Morgan has calculated that human subjects would be able to tolerate continuous breathing for one year of an atmosphere containing carbon particles with the average activity of 1.15×10^{-7} microcuries per cc of air.

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However, if the exposure is for a 40-hour week, the latter quantities of microcuries are multiplied by 4.2. In the case of breathing labeled CO_2 the elimination would be very great and it is expected that the concentration would have to be high to be hazardous. Values are not presently available, however, for this circumstance.

Survey of C 14 Needs.

The Manhattan Project has been successful in preparing increased quantities of C 14 for non-Project distribution. This office would appreciate your re-examining proposed research programs in this light and receiving estimates of the amounts of C 14 which you could use in your investigations.

We would also like to know the kinds of intermediates and radicals labeled with C 14 in which you would be most interested.

Efficiency of Measurement.

Due to the weak beta energies which arise from C 14 disintegrations, this office would like to point out data calculated relative to transmission of C 14 beta particles through some window thickness of Geiger Counters. These calculations are partially based on the publications by Ruben and Kamen, Physical Review 57, 549 (1940) and 59, 349 (1941). It has been estimated by calculation the following: A mica window of 5.9 mg/cm^2 would transmit only 14% of all the beta radiation from C 14; window of 4.7 mg/cm^2 would transmit 28%; window of 3.0 mg/cm^2 would transmit 43%. For efficient measurement of C 14 it is evident that very thin windows are highly desirable. Efforts should be made to induce radioactivity measuring instrument manufacturers to make thin flat mica end-window counters with a window of no greater than 2-3 mg/cm^2. The possibilities of using an ionization chamber (for solid or gas samples) with a stable sensitive electrometer system should not be overlooked.

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