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COMPARISON OF TWO BACKGROUNDS ON ^{14}C ACTIVITY MEASUREMENT WITH LSC (LIQUID SCINTILLATION COUNTING)

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ABSTRACT

Comparison of the two types of background on ^{14}C activity measurement has been carried out. This study aims to determine a better background for ^{14}C activity measurement using the LSC (Liquid Scintillation Counting) method. The background used consists of two, namely background I and background II. Background I is a marble solution that has been absorbed using 30% DEA. Background II is a 30% DEA solution. Activity measurement of ^{14}C was carried out using Hidex 300 SL liquid scintillation counter (LSC). Activity ^{14}C background I is 99,389 DPM. While Activity ^{14}C background II is 101,178 DPM. This shows that the background that is better used for measuring Activity ^{14}C is background I, which is a marble solution that has been absorbed using DEA

Keywords: LSC (Liquid Scintilation Counting), ^{14}C, Activity ^{14}C, DEA, Marble

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1. INTRODUCTION

Determination of age of coral reefs can be known through radiocarbon dating methods. This method is based on the calculation of ^{14}C activity which is still contained in a carbon sample. The value of this activity is then converted to age after being compared with modern reference standards. Radioisotope ^{14}C is produced in the upper atmosphere by the reaction between cosmic radiation and nitrogen to form ^{14}C. When a subsystem (tree, sea shells etc.) is isolated from a global system (eg a tree is cut down, or dead and buried in the soil) then there is no more ^{14}C added to it, the ^{14}C activity begins to decrease according to the radioactive decay law [1].

In recent years experts have developed a liquid scintillation counting method because the previous method is quite complicated. Liquid scintillation counting method is now not only used for enumerating low-energy β radiation, but can also be used for total enumeration of α and β. This method is known as LSC (Liquid Scintillation Counting). The advantage compared with the previous method is that the liquid form makes it easy for the sample to be dissolved homogeneously, so that there is no effect of self absorption. This method can detect ^{3}H and ^{14}C, and can determine the total α and β at once, so that it can save time [2]. The method of determining age using ^{14}C has been done by counting C_6H_6 with a liquid scintillation counter, counting C in graphite form with Accelerator Mass Spectrometry, and chopping CH_4 with Mini Gas Proportional Spectrometry. These methods are done with sample preparation that is quite complicated, long, and requires consideration of adequate technical skills so that for hydrological research in particular it is considered not economical and efficient, because only one sample can be analyzed a day [3].

The last two decades have adopted a new method of CO_2 absorption method. CO_2 absorption method is often referred to as $^{14}CO_2$ direct counting method, because the content of ^{14}C in CO_2 is directly chopped with liquid scintillation counter. Sample preparation with this method involves the use of CO_2 absorbing chemicals which are generally available in the form of carbosorb solutions and a solution of scintillation (scintillator) Permafluor-V, both from Packard Co. However, currently Packard is no longer producing these two ingredients, so laboratories ^{14}C in several countries develop their own substitutes for these chemicals [3].

Kim, et al. (2013) reported that alkanolamine compounds such as MEA, DEA and TEA are reactive carbosorbents. Carbosorb DEA shows higher CO_2 absorption than MEA and TEA. Each sample measurement depends on the sensitivity of the detector to cosmic rays in the atmosphere, so it is necessary to correct the measured isotope activity number ^{14}C, namely the background counting. The problem often encountered in measuring ^{14}C activity is determining a better background to determine the specific activity value of a sample. Therefore, this research was conducted by comparing two types of background [4].

Marble is used as the background I. Marble is given the same treatment as the sample which is absorbed using 30% DEA and is considered as a source of CO_2 [5][6] Marble Mine, Jennae Village, Pangkep Regency, South Sulawesi, Indonesia The reason for using marble as a background is

that marble includes dead carbon, Dead carbon is a material that is considered not to provide radioactive activity or its activity is close to zero and is used as a correction to counted atmospheric cosmic rays by LSC, each measurement of a sample depends on the sensitivity of the detector to cosmic rays in the atmosphere, so it is necessary to correct the measured isotope activity number ^{14}C, that is by using background counting.The background used is very old carbon, then marble is selected as the sample corrector.

30% DEA is used as background II. The 30% DEA used is 30% DEA without sample absorption. The use of background II is considered as a correction to calculate the activity of ^{14}C in the sample by comparing activity with absorption and without absorption.

2. METHOD

This research was conducted at the Laboratory of Chemical Radiation, Department of Chemistry, Faculty of Mathematics and Natural Sciences, Hasanuddin University, Makassar, South Sulawesi, Indonesia.

Backgrounds I and II are pipetted as much as 8 mL and mixed with 12 mL of scintillator in a 20 mL vial. The mixture was homogenized by shaking and kept from light interference, and placed in LSC tray. Background I and II were enumerated with Hidex 300 SL LSC with enumeration time of 5-150 minutes. After obtaining optimum time, background I and II were counted again with 12 repetitions.

3. RESULT AND DISCUSSION

The results of the measurement of ^{14}C activity with Hidex 300 SL SL are in the form of a minute value per minute (CPM) which shows the number of β particles produced from ^{14}C in a sample of coral reefs every minute, and the value of Disintegration Per Minute (DPM) which shows the number of atoms ^{14}C decays in the sample every minute. The relationship between the DPM value and CPM value is shown as a unit of efficiency count called the Triple to Double Coincidence Ratio (TDCR).

Determination of the optimum enumeration time is done to determine the best time generated DPM value and has a stable count efficiency (TDCR) as a sign that the sample counting process is running optimally. In the 90th minute the activity value of ^{14}C starts to reach stability. The optimum counting time of background I and II is determined based on figure 1. The optimum time of counting in background I and background II is 90 minutes

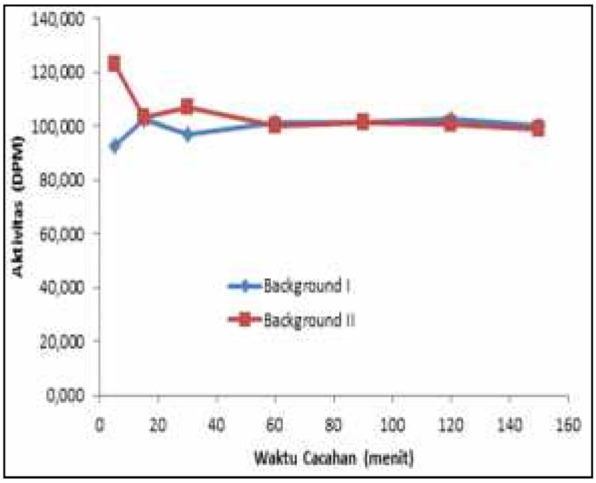

Figure 1. Determining the Optimum Time of Background Background I and II

To determine the value of activity, enumeration of background I and II was carried out at the optimum time of enumeration of 90 minutes each. This enumeration was carried out 12 repetitions, so that the average background activities of I and II can be seen in table 1. The average activity data is then used to determine the specific activity value of the sample.

Based on table 1, it can be seen that the average ^{14}C activity of background I is 99,389 DPM. While the average ^{14}C activity of background II is 101,178 DPM. This shows that background I is more appropriate as a background for measuring the activity value of ^{14}C because it has a smaller average activity value of ^{14}C.

Table 1. Enumeration Results Background I and II

Background I (DPM)	Background II (DPM)
98,950	100,610
99,010	100,450
99,460	102,410
100,500	100,320
99,790	100,220
99,010	100,350
99,010	101,870
98,880	102,340
100,970	102,720
98,300	101,570
100,420	100,490
98,370	100,780
99,389	101,178

4. CONCLUSION

Background marble is better used as a background in measuring ^{14}C activity

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