Application of the ADVNAA program for k_0-NAA

Y. S. Chung,[a] J. H. Moon,[a] J. O. Kim,[a] S. H. Kim,[a] Y. J. Kim,[a] Bangfa Ni [b]
a Korea Atomic Energy Research Institute, 150 Duckjin-Dong, Yuseong-Ku, Daejeon, Korea, yschung@kaeri.re.kr
b China Institute of Atomic Energy, Beijing, China, bfni@iris.ciae,ac.cn

1. Introduction

k_0-NAA has been developed as an absolute standardization method and applied in many NAA laboratories throughout the world for the analysis of practical samples [1,2]. For the effective use of the k_0-NAA method in a routine analysis, an appropriate software program should be used in every laboratory. However, our laboratory has not had a complete program as yet and has used only EXCEL spread sheet for the calculation of the elemental concentration by k_0-NAA. To improve inefficiency in the process of the calculation by k_0-NAA, an attempt was made to apply a program that is called "ADVNAA" developed by the China Institute of Atomic Energy, China. This study has a look into the operational procedure for an important menu function of the ADVNAA program which was modified for our measurement system. For the verification of the method, a certified reference material was used as a control sample.

2. ADVNAA software

Fig. 1 shows the main menu of ADVNAA including File, Standard, Sample Analysis and so on. To calculate an elemental concentration from a report file which contains the relevant information for the nuclides of interest in the measured spectrum, pre-requisite values, efficiency according to gamma-ray energy at the counting position, the predetermined k_0-parameters in terms of α and f and the k_0-factors for the nuclides of interest are necessary. Among these, the k_0-factors for all the gamma-ray energies of the nuclides of interest with regards to neutron activation analysis were input into the program.

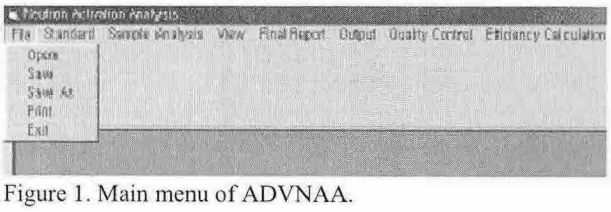


Figure 1. Main menu of ADVNAA.

2.1 Build a Standard File

The first step of ADVNAA is to establish a standard file. For this, it can be made by a click of the 'Standard' button and then a click of the 'Build Standard File. Fig. 2 shows the display for the setting parameters to build a standard file.

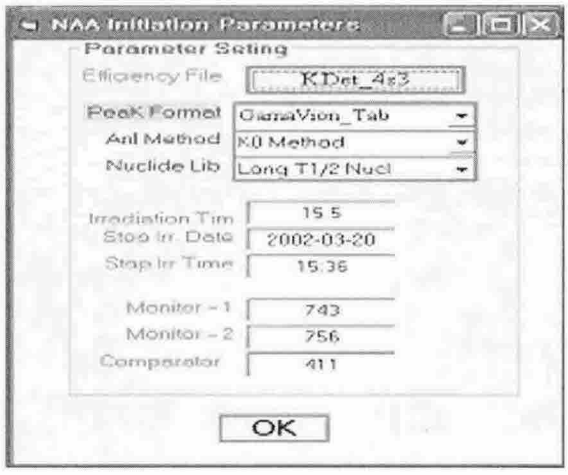


Figure 2. Parameter setting to build a standard file.

In particular, the 'Efficiency File' in Fig. 2 can be created from the 'Efficiency Calculation' menu in the main menu and Fig. 3 displays screen to make an efficiency file.

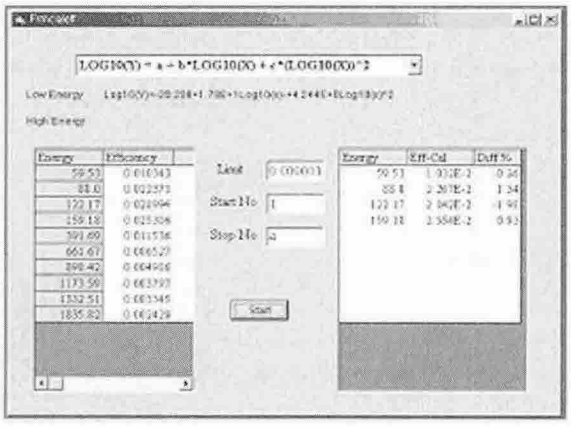


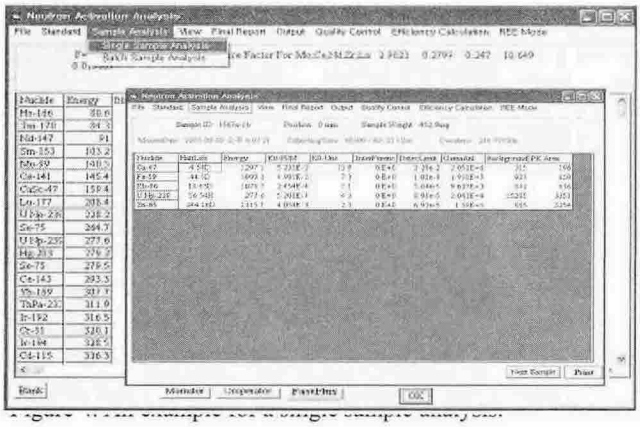
Figure 3. Screen to make an efficiency file.

When an efficiency file is made, k_0-parameters are input and peak format(GammaVision) are selected, a new standard file has been created and it is used for the calculation of the elemental contents by the ADVNAA program.

2.2 Sample Analysis

A Sample Analysis consists of two submenus, 'Single Sample Analysis' and 'Batch Sample Analysis'. In the case of a Single Sample Analysis, click the 'Single Sample Analysis' button and find the standard file to be used. Then, find the sample peak file and click the 'OK' button. The results will be displayed on the

screen and also saved with the same name as the standard file name, but the extension of the file will be changed into *.nrp. If you click the next button, the next sample will be analyzed. In the case of a Batch Sample Analysis, first of all, we have to edit a batch file for the effective analysis of lots of samples. To make a batch file, we can use any ASCII code editor like EXCEL and each data set should be saved by the comma divided format like *. csv. The calculation procedure by the Batch Sample Analysis is almost the same as the Single Sample Analysis. Fig. 4 shows an example of the calculation results by a single sample analysis.



2.3 View and Final Report

'Analytical Results', 'Peak File', 'SRM_Lib', 'Flux parameters', 'Nuclide Lib' are presented by clicking the 'VIEW' menu in the main menu. If you click 'Analytical Results', you can recall and see previous results as shown in Fig. 5.

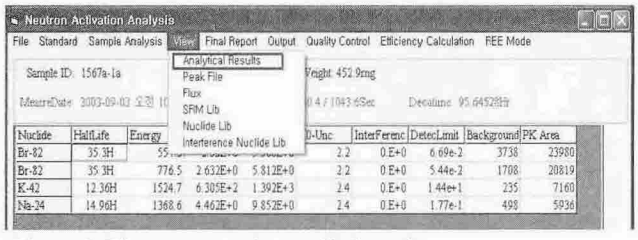


Figure 5. View menu and a recalled result.

In the Final Report menu, some of the calculated analytical results can be selected as a final report. To perform this step, after a *.nrp file is opened, if you click the cell to check(yes) or uncheck(No), a final report file(Fig. 6) can be made and saved with the same name as report(*.nrp) file, but the extension of the file name is *.naa.

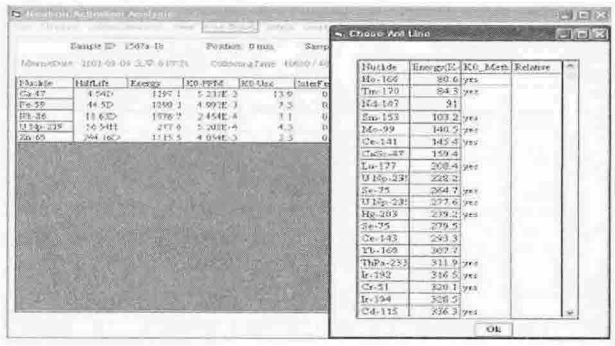


Figure 6. An example to make a final report.

2.4 Results of the CRM analysis

14 elements in NIST SRM 2709, San Joaquin Soil were determined using the ADVNAA program and the measured spectra. The relative errors between the calculated values and certified values are shown in Fig. 7 and they are within 13% except for Mg. These results indicate that the ADVNAA program can be applied for the analysis by k_0-NAA in our laboratory.

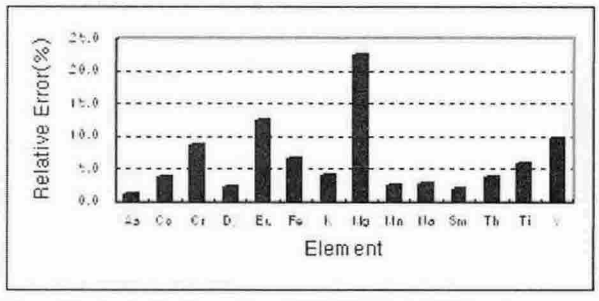


Figure 7. Analytical results of NIST SRM 2709 by ADVNAA.

3. Conclusion

The modified ADVNAA program was performed effectively using two calculation modes. For the verification of this method, elemental contents in a CRM were calculated and the results are agreed well with certified values.

REFERENCES

[1] F. De Corte, A Survey of Recent k0-NAA development and applications in Europe, Journal of Radioanalytical and Nuclear Chemistry, Vol.**234**, p.9, 1998.

[2] B. Torres, E. Montoya, P. Mendoza, P. Bedregal, M. Ubillus, P. Olivera, Determination of Gold and Siler in Copper Concentrates Using k_0 Based Neutron Activation Analysis, Journal of Radioanalytical and Nuclear Chemistry, Vol.**257**, p.597, 2003.