INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF ANCIENT GLASS EXCAVATED IN ENEZ (ANCIENT AINOS) TURKEY

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Enez (Ancient Ainos), in the Northern Coast of the Aegean Sea, has been described as one of the most important archaeological sites in Turkey. The first residents of Enez have not been known yet but the found remains were dated back to 7300 years from now and life in here has continued till today. The excavations in Enez have been going on for the last 30 years.

Glass production has been known from antiquity (3000 BC in Syro-Palestine area and 1500 BC in Egypt), but in due course, the composition of glass varied with the purpose of improvement of its quality. It was a long way of search of both materials and their fractions and as a result of century practice the fractions of separate components were determined as: one portion of either Na_2O or K_2O, and one portion of CaO or PbO and six portions of SiO_2. The investigation of the nature of the raw materials and the technology implemented for production of the glasses is important, since it gives us a better understanding of the civilization.

The aim of this research is to determine the chemical composition of the basic components and coloring elements of the glassware depending on time and a place of production. We have investigated 15 glass fragments belong to Hellenistic, Roman, Byzantine and Ottoman Periods for determination of their chemical composition using instrumental neutron activation analysis.

The glassware bits of 0.01 – 0.05 g were irradiated simultaneously with reference materials for 70 hours at thermal neutron flux density of 6.5 10^{10} cm^{-2} s^{-1} in the nuclear reactor of Institute of Nuclear Physics, Tashkent, Uzbekistan. For measurement and treatment of the sample spectrum gamma-spectrometer was used with HPGe coaxial gamma-ray detector (the resolution 1.8 keV at 1332.5 keV, relative efficiency 15 %), charge sensitive preamplifier and multichannel analyzer DSA-1000 with software Genie-2000 (Canberra industries). Na, K, and Ca compositions of the samples together with coloring elements Mn, Fe, Co, Cu, As, Rb, Sb and impurities Sc, Cr, Zn, Sr, Cs, Ba, Ce, Sm, Tb, Eu, Yb, Lu, Hf, Ta, Au, Th were determined.

Glasses have been divided into three groups as a result of the analysis of the basic components; potassium- limy (I), sodium –potassium- limy (II) and sodium limy glasses (III). Mn, Cu and Sb were found as coloring agents of the Hellenistic and Roman glass fragments of sodium

limy glasses (III). Sodium –potassium- limy glasses (II) were found related to Byzantine Period. In ancient glass iron, which comes from the row material (sand), is present at levels which can impart green coloration. In order to minimize the effects of iron colors, manganese oxides or salts was added in sodium-potassium limy glasses. Potassium-limy glass has been invented between 1670 and 1680 AD at glass making works in Bohemia (I) and related to Ottoman Period, Co, As and Rb were used as coloring agents.