LETTERS TO THE EDITOR

ON THE DETERMINATION OF K-CONVERSION COEFFICIENTS

One of the known methods of determining K-conversion coefficients consists of measuring the number of K X-rays, \( N_{\gamma} \), which accompany internal conversion in the K-shell relative to the number, \( N_{\gamma} \), of unconverted \( \gamma \)-rays. If the measurement is made with a NaI(Tl) scintillation spectrometer the K-conversion coefficient \( a_k \) is given by the relation

\[
a_k = \frac{N_{\gamma}e_{\gamma}A_{\gamma}}{N_{\gamma}e_{\gamma}w_kA_kI_k}\]  

(1)

where \( N_{\gamma} \) and \( N_{\gamma} \) represent the counts under the photo-peaks in the spectrum of the source for K X-rays and \( \gamma \)-rays, \( e_{\gamma} \) and \( e_{\gamma} \) denote the photo-peak efficiencies and correspond to the fraction of X-rays and \( \gamma \)-rays that lose full energy in the NaI(Tl) crystal of the detector, \( A_k \) and \( A_{\gamma} \) account for the absorption of the X-rays and \( \gamma \)-rays in the air and the crystal package before reaching it. \( \omega_k \) is the K-shell fluorescence yield and accounts for those de-excitation of the excited daughter atom which result in the ejection of Auger electrons and \( I_k \) corrects for the escape of iodine X-rays from the crystal which are subtracted from the K X-rays photo-peak and reappear in the so-called ‘escape peak’. The errors in the determination of \( a_k \) arise mainly because of the uncertainties in the value of the factor

\[
\frac{e_{\gamma}A_{\gamma}}{e_{\gamma}w_kA_kI_k}
\]

We have measured the value of this factor experimentally. The principle of the method and the results are briefly described in this letter. The experimental details are omitted and will be reported elsewhere.

662 keV gamma-rays from Cs-137 source of strength about 200 mc. were scattered from a thin lead target through an angle of 90°. The X-rays of weighted mean energy (76.7 keV) emerging from the target as a result of photoelectric interaction and the Compton scattered gamma-rays of energy 280 keV from the target were recorded with the (1" × 1") NaI (Tl) detector which was later used to determine \( a_k \) in TiO\(_2\). The ratio of the K X-rays and the Compton scattered \( \gamma \)-rays as measured under the photo-peaks of the spectrum of the radiation emerging from the target is given by the relation

\[
\frac{N_k}{N_c} = \frac{a_k}{a_{\gamma}} \frac{t_{\text{eff},k}}{t_{\text{eff},c}} \frac{e_{\gamma}A_{\gamma}}{e_{\gamma}w_kA_kI_k}
\]

where \( a_k \) and \( a_{\gamma} \) are the photoelectric and Compton scattering cross-section for 662 keV gamma rays in lead. \( t_{\text{eff}} \) is the effective thickness of the target which takes into account the absorption of the incident and the emerging radiation in the target. The ratio of effective thicknesses was determined experimentally by using targets of thicknesses \( t, 2t, 4t \ldots \ldots \) etc., as described earlier. The other terms have been defined earlier. Twelve independent runs were made and the value of the factor

\[
\frac{e_{\gamma}A_{\gamma}}{e_{\gamma}w_kA_kI_k}
\]

was found to be 0.483 ± 0.017. The target was then replaced by a weak Hg-203 source which emits K X-rays due to internal conversion in Ti-203 and the 280 keV unconverted gamma-rays and the spectrum was taken with the same geometry. The values of \( N_{\gamma} \) and \( N_k \) were determined from the analysis of the spectrum. Since the energies of the Compton scattered \( \gamma \)-rays and K X-rays emitted from the lead target are almost the same as those of the Ti-203 \( \gamma \)-rays and K converted X-rays, the value of the factor

\[
\frac{e_{\gamma}A_{\gamma}}{e_{\gamma}w_kA_kI_k}
\]

is the same as that of

\[
\frac{e_{\gamma}A_{\gamma}}{e_{\gamma}w_kA_kI_k}
\]

The value of \( a_k \) was calculated from equation (1) to be 0.159 ± 0.006 which is compared with the previously determined values by this method in Table I.

**Table I**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Measured value</th>
<th>Reference No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.23 ± 0.01</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0.21 ± 0.01</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>0.160 ± 0.01</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>0.165 ± 0.014</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>0.153 ± 0.005</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>0.175 ± 0.004</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>0.159 ± 0.006</td>
<td>7</td>
</tr>
</tbody>
</table>
Physics Department, Punjabi University, Patiala, August 9, 1967.

H. S. Sahota.
B. S. Sood.


ULTRASONIC STUDIES OF BINARY LIQUID MIXTURES: ANILINE-BENZENE AND ANILINE-CARBON DISULPHIDE

Sette\(^1\) studied the ultrasonic absorption of binary liquid mixtures of aniline with nitrobenzene and ethyl alcohol and reported a minimum in absorption at about 0·3 mole fraction, for both the binary mixtures and attributed this to molecular association, in the case of these polar liquids. Balschandran\(^2\) reported a linear variation of velocity and compressibility of aniline-cyclohexane liquid mixture. From a study of the temperature dependence of absorption coefficient of pure aniline, Nomoto et al.\(^3\) concluded that there is a contribution from bulk viscosity to ultrasonic absorption in this liquid.

With a view to study the behaviour of aniline with some other solvents, the authors have taken up the binary liquid mixtures, aniline-benzene and aniline-carbon disulphide. The absorption measurements are made with an error of ± 3% employing pulse technique as developed by Pellam and Galt\(^4\) and Pinkerton.\(^5\) The velocity measurements are made to an accuracy of ± 1 m/sec., using an acoustic interferometer. The liquids benzene and carbon disulphide supplied by E. Merck and aniline by B.D.H. are used after distillation. Aniline is added to the solvents with a pipette of one ml. capacity and the mole fractions are estimated. The densities of pure liquids and mixtures are obtained using sensitive hydrometers, correct to third decimal place. For the binary mixture of aniline-benzene, the velocity and absorption measurements are made at a frequency of 8·9 mc/s and at a temperature of 26·5° C. In view of the large absorption coefficient for carbon disulphide, the measurements are made at 2·86 mc/s for aniline-carbon disulphide mixture at a temperature of 22° C.

Figures 1 and 2 give, for the two binary mixtures aniline-benzene and aniline-carbon disulphide respectively, the variation of absorption (α/F\(^2\)), the velocity and adiabatic compressibility with increasing concentration of aniline. It is found that in both the liquid mixtures, the velocity goes through a minimum at about 0·05 mole fraction of aniline and the adiabatic compressibility shows a maximum at the same concentration. This is similar to the occurrence of a velocity minimum at a low concentration, when a polar liquid is dissolved in a non-polar solvent as, for example, in the case of ethyl and methyl alcohols dissolved in carbon tetrachloride,\(^6\) which may be ascribed to the presence of maximum number of polar molecules for this particular concentration.

The absorption values for both the liquid mixtures show the usual rapid monotonic