CHAPTER 5 - Conclusion

The transmission method provides a convenient and accurate way to determine gamma-ray mass attenuation coefficient for both liquid and solid material. Liquid samples used in this study are n-pentane, ethanol, toluene, olein, oil sludge and distilled water with density ranging from $0.62 g/cm^3$ to $1.00 g/cm^3$. The solid samples are polyethylene, brick, cement and concrete with density ranging from $0.90 g/cm^3$ to $2.28 g/cm^3$. To obtain an optimised experimental design, a compromise between high sensitivity and minimum error was implemented. Measured values of the transmission ratio and mass thickness directly influence the precision of the experimental mass attenuation coefficient values. Even with a narrow-beam geometry, if the thickness of the absorber is greater than one mean free path, multiple scattering could affect the measured value of the attenuation coefficient.

For the purpose of comparison, derived values from published data from Hubbell[3] and M.N. Alam[17] were taken as the expected values for the experiment. Differences from the two sets of data for each sample were calculated as relative difference percentage (%RD). At 356keV, the %RD ranges from 3.7% to 19.5% and at 662keV the %RD ranges from 12.2% to 32.8% respectively. The relatively high difference at 662keV is mainly due to experimental design, especially in the underestimation of mass thickness. At higher energy, the measured values which were most affected were the least dense material, i.e. density less than $1 g/cm^3$.

The findings of this project are as described below:

a) For a given gamma ray energy and for a material of specified chemical composition, μ/ρ is a constant. Experimental values were obtained for n-pentane, ethanol, toluene, olein, oil sludge, distilled water, polyethylene, brick, cement and concrete.

b) The relation between the mass attenuation coefficients and gamma ray energy shows that it decreased with increase of gamma ray energy for the same material.

c) Measurements of mass attenuation coefficient follow closely the published values for distilled water and toluene at sample position closer to source. For ethanol, the best-measured value occurred at sample position closest to both source and detector.

d) It is possible to determine the gamma ray mass attenuation coefficient for an unknown sample by comparing it with the coefficient value of a comparable density and chemical composition of a known sample.

The experimental design for the current study could be improve by re-calculation of a more suitable absorber dimensions. Experimental values could be made more accurate by having adequate mass thickness. A suggestion for improvement in this study is to carry out studies of dimensions of the absorber in directions perpendicular to the incident gamma ray beam especially for liquid.

The values of mass attenuation coefficient could also be obtained from the perspective of contribution from each interaction of gamma ray and matter. For example,

each μ/ρ for each interaction could be studied for the different samples. [μ/ρ (Total) = μ/ρ (Photoelectric) + μ/ρ (Compton) + μ/ρ (Pair Production)]. A study could be made for the Z-dependence of atomic photoelectric and coherent scattering in multi-element materials. The study could also be extended to the energy regions in which the influence of all interaction processes can be observed.