APPENDIX
APPENDIX - I

THE JONES MATRIX REPRESENTATION OF A LINEAR POLARIZER

Jones matrix of an ideal linear polarizer can be written as

\[
P(\theta) = \begin{bmatrix}
\cos^2 \theta & \sin \theta \cos \theta \\
\sin \theta \cos \theta & \sin^2 \theta
\end{bmatrix}
\]

\[\text{(1)}\]

where \( \theta \) is the angle between the transmission axis of the linear polarizer and the x-direction of a chosen cartesian co-ordinate system. The matrix \( P(\theta) \) is Hermitian and satisfy the idempotency condition \( P(\theta) P(\theta) = P(\theta) \). Here we use the term 'ideal' because we neglect the depolarizing tendencies caused by scattering, oblique reflections, edge effects, internal strains etc. since these effects are very marginal. However if we consider two wavelength dependent principal transmittances \( K_1(\lambda) \) and \( K_2(\lambda) \), the Jones matrix of the linear polarizer is given by

\[
P(\theta) = \begin{bmatrix}
\cos \theta & -\sin \theta & K_1(\lambda) & 0 \\
\sin \theta & \cos \theta & 0 & K_2(\lambda)
\end{bmatrix}
\]

\[
= \begin{bmatrix}
K_1(\lambda) \cos \theta & -\sin \theta K_2(\lambda) & \cos \theta & \sin \theta \\
K_1(\lambda) \sin \theta & \cos \theta K_2(\lambda) & -\sin \theta & \cos \theta
\end{bmatrix}
\]

\[\text{(2 contd.)}\]
\[ K_1(\lambda) \cos^2 \beta + K_2(\lambda) \sin^2 \beta = \begin{vmatrix} K_1(\lambda) \cos^2 \beta + K_2(\lambda) \sin^2 \beta & (K_1(\lambda) - K_2(\lambda)) \sin \beta \cos \beta \\ (K_1(\lambda) - K_2(\lambda)) \sin \beta \cos \beta & K_1(\lambda) \sin^2 \beta + K_2(\lambda) \cos^2 \beta \end{vmatrix} \]

Here major principal transmittance \( K_1(\lambda) \) is defined as the ratio of transmitted intensity to incident intensity when the incident beam is linearly polarized in that the vibration azimuth that maximizes the transmittance. The ratio obtained when the transmittance is minimum is called minor principal transmittance \( K_2(\lambda) \). Substituting \( K_1(\lambda) = 1 \) and \( K_2(\lambda) = 0 \) in equation (2) we get back the ideal equation (1). The \( K_1, K_2 \) values of different types of HN and KN sheet polarizers at different wavelengths are shown by Schurcliff [1]. A good summary of the development of sheet polarizers is given by E.H. Land [2]. Recently some improvements in \( K_1, K_2 \) values have been reported by Gunning and Foschaar [3]. However the values of \( K_1, K_2 \) for some specific wavelengths have been found very near to their ideal values and as such their effects on the performance of the linear sheet polarizer for those wavelengths are negligible.

For our computational purpose we have considered the variations of \( K_1, K_2 \) with the variation of \( \lambda \) of a sheet polarizer as shown by the Figures (a) and (b).

Fig. (a) shows the variation of principal major transmittance \( K_1 \) with the variation of wavelength \( \lambda \) of a HN-33 sheet polarizer.
The vertical and the horizontal scales are linear in $K_1$ and $\lambda$. The curve is plotted by the known values of $K_1$ where the variation of $K_1$ between two consecutive wavelength interval (Table 4.1, Ref.1) is assumed linear.

Similarly Fig.(b) shows the variation of principal minor transmittance $K_2$ with the variation of wavelength $\lambda$ of a HN-38 sheet polarizer. Here also the vertical and the horizontal scales are linear in $K_2$ and $\lambda$. The variation of $K_2$ between two consecutive wavelength interval (Table 4.1, Ref.1) is again assumed linear.

REFERENCES


Fig. (a)