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Prepared contribution by H W Kropholler relating to 'Forming and Formation of Paper' presented by R R Farnood

In this excellent paper a relation between flocculation index and M/K formation index is presented in their figure 7 (p197). In this contribution an on-line method for estimating the size and intensity of flocs in the finished paper is presented. A line-diagram of the equipment is shown in figure 1. A 200mm square image is captured at a resolution of 512 x 512 pixels using a ccd camera and a 0.8 microsecond flash. Thus the maximum machine speed will be between 500 and 700m.min^{-1}. Typical transmitted images of paper flocculated to differing degrees are shown in figures 2 and 3. The 2D-fft representation of the power spectrum of the image is analysed for a given frequency range at a predetermined radial distance from the centre as shown in figure 4. The maximum and minimum frequencies are chosen as follows. The lowest frequency, fmin, represents the maximum expected floc size and the highest frequency, fmax, represents an arbitrary choice for what the user would consider to be the smallest feature representing a floc. As there is no reason why the flocs would be distributed in any systematic manner integrating the power for a series of concentric circles over the range shown in figure 4 the fractional energy at all the frequencies (or wavelength or floc sizes) can be calculated and plotted. Figure 5 shows the curves obtained from three samples of different floc size and intensity. Highly flocculated papers have a high energy and even a peak at the dominant floc size. Better formed papers exhibit no peak. A single parameter or index of floc intensity, I', can be calculated as follows:

$I = \sum (I(x).x) / \sum x$ summed from xmin to xmax.

Similarly an average floc size can be calculated as:
$x = \Sigma (I(x).x)/ \Sigma I(x)$ summed from xmin to xmax.

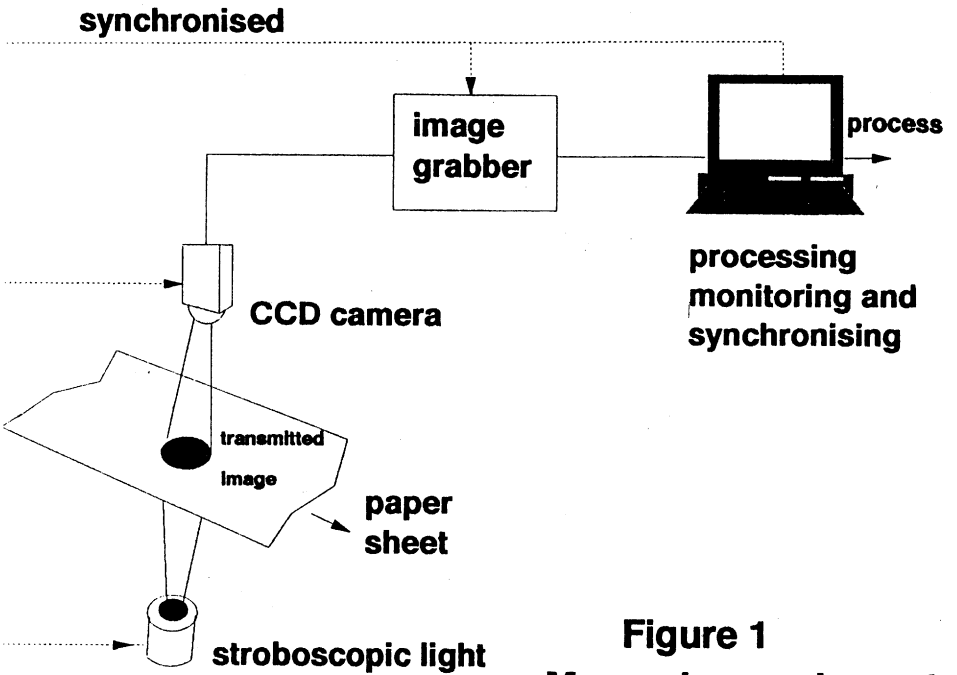


Figure 1
Measuring equipment

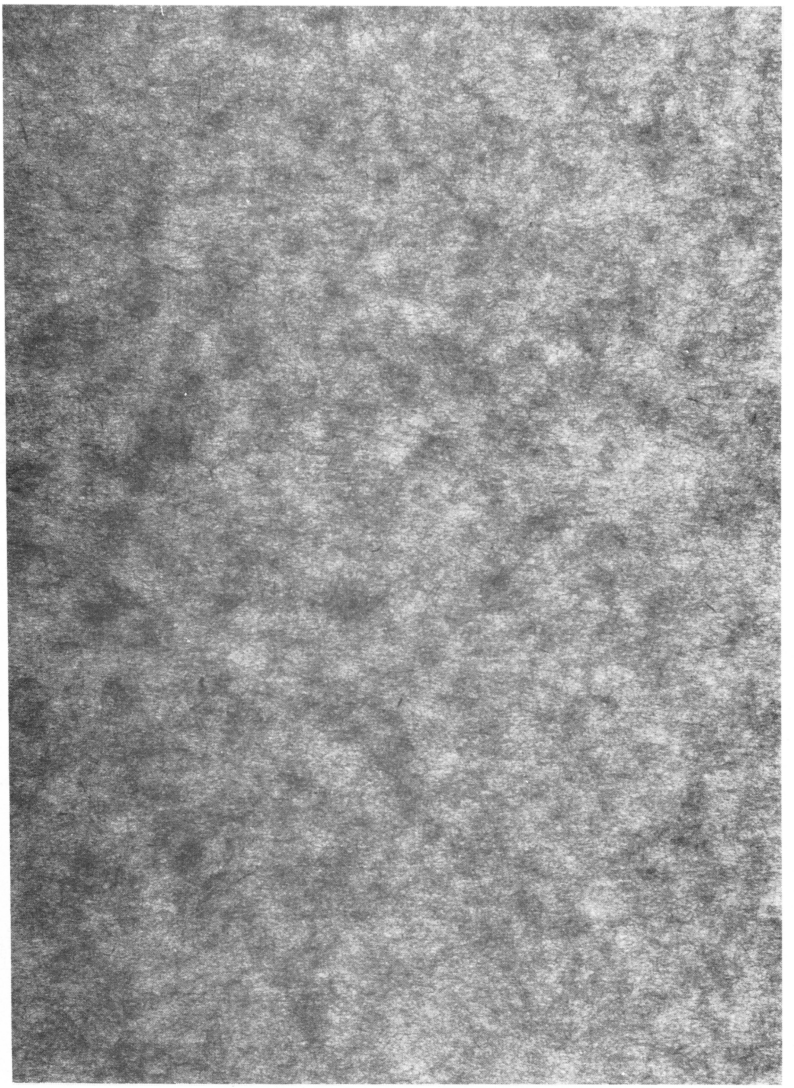


Figure 2 Example of paper with medium flocculation

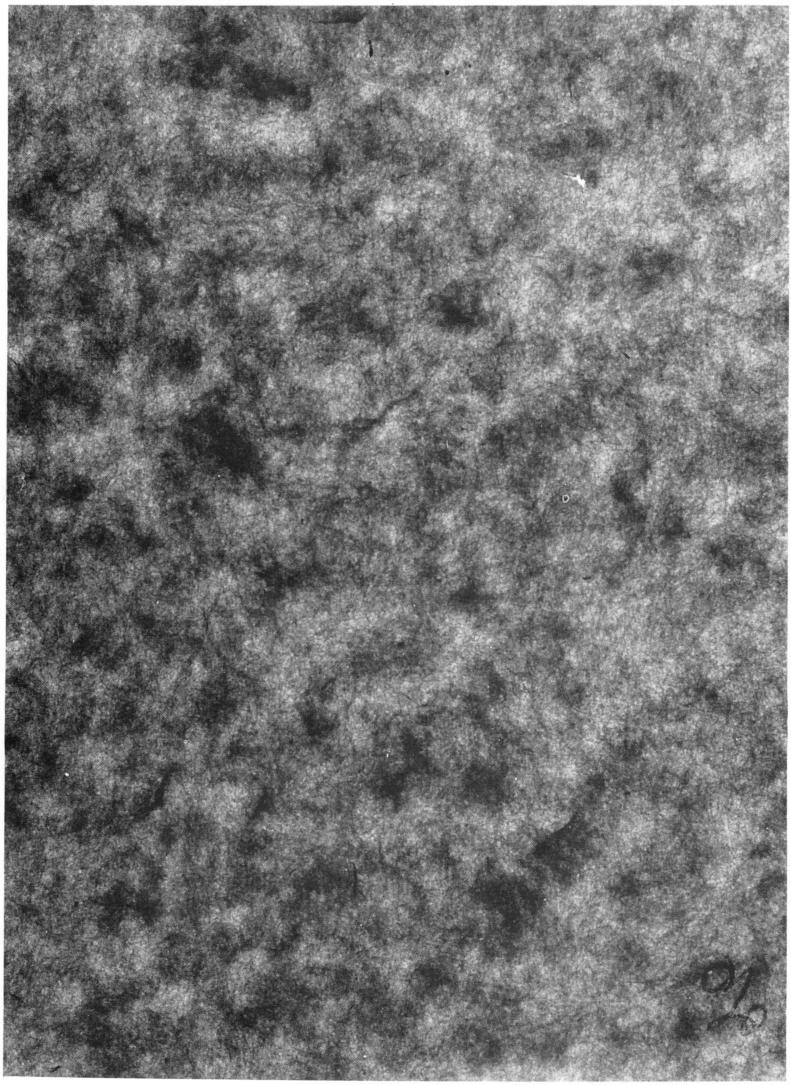
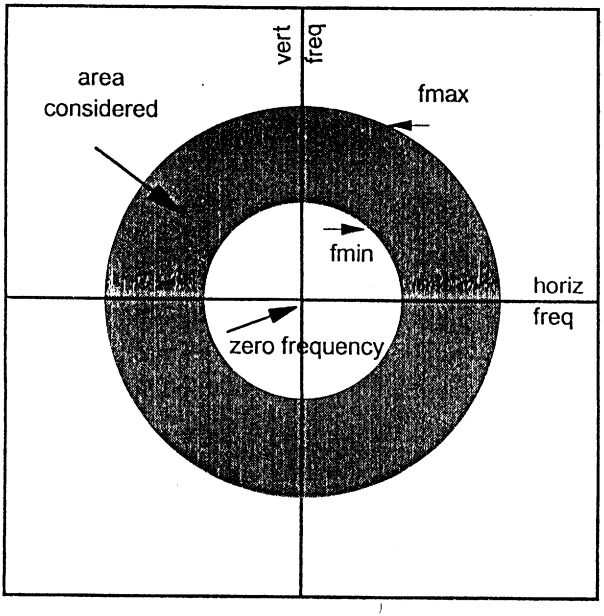


Figure 3 Example of paper with high flocculation

Fig 4 Two-dimensional Power Spectrum



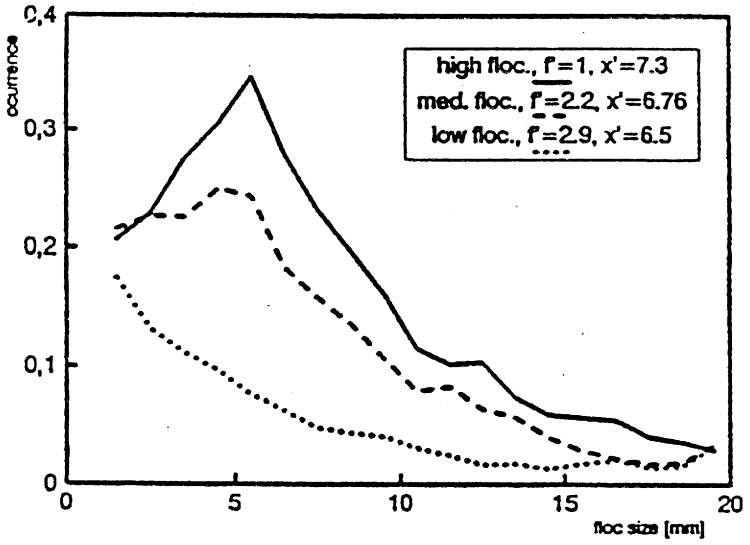


Fig.5 Floc size energy distribution