SYNOPSIS.

OPTICAL METHODS TO DETERMINE THE PARTICLE SIZE DISTRIBUTION IN SUSPENSION.

In the present investigations the particle size distribution in certain colloids is studied by optical methods. The study was undertaken with a view to investigate the following:

(i) to correlate the results obtained by different optical methods used to determine the particle size distributions.

(ii) to investigate the relative merits and limitations of the different methods.

(iii) to estimate the effect of shape factor on the determination of size distribution.

Following three different methods were used for this purpose.

(1) The rate of sedimentation in a differentially settling column of liquid was determined by measuring the transmissivity of the colloid at different time intervals. The graph of particle size distribution was obtained from the curve of transmissivity versus time.
The intensity of the light scattered in the forward direction at different narrow angles was accurately measured. Particle size distribution curve was determined by applying Kirchhoff diffraction theory to these measurements.

The changes in the optical transmission through the colloid placed in a magnetic field was accurately measured at different field strengths and from these measurements the particle size distribution curves were obtained in certain cases.

The following colloidal suspensions were selected for the study.

1. Suspension of pyrex glass, prepared by dropping the heated glass powder in water.

2. Suspension of rouge, prepared by grinding the commercial rouge powder and then mixing it with water to get a suspension of fine particles.

3. Aquadag graphite suspension prepared from the commercial paste of graphite supplied by Acheson Colloid Ltd.

4. Oildag graphite suspension, prepared in kerosene by the same method stated above.
The sedimentation method was applied to the suspension of glass and rouge. The forward light scattering pattern for glass, rouge and aquadag graphite colloids were studied. The magneto-optical method was applied to oildag and aquadag graphite.

The results of the experiments are discussed below:

(1) In the case of glass suspension the results obtained by both the methods are in fairly good agreement. The suspension was found to be polydispersed with maximum number of particles at $x = 16 \left( x = \frac{2 \pi r}{\lambda} \right)$.

(2) In the case of rouge suspension, it was observed that the sedimentation method gave a lower value of the particle sizes compared to that given by forward scattering method. Thus the forward scattering method gave the maximum number of particles at particle size parameter $x = 5$, while sedimentation gave at about $x = 3.8$. This may probably due to the non-spherical (disc shaped) shape of the rouge particles.

(3) In the case of aquadag graphite results obtained by forward scattering method agree well with those obtained by magneto-optical method.

(4) The results obtained in oildag graphite by magneto-optical methods show that the particles of graphite obey log-normal distribution law with a maximum number of
particles at about $x = 3.20$. The shape of the particles was also determined by this method. The graphite particles were found to be oblate spheroids with 6.5 as the ratio of their axes.

Application of the forward scattering method to colloidal graphite and rouge requires investigations about the validity of Kirchhoff diffraction theory to the spheres of absorbing material. For this purpose computations of intensity functions were carried out on the basis of Mie theory for

(i) $m = \infty$ for particle size parameters
   $x = 1, 2 \ (2) \ to \ 10 \ (5) \ to \ 20$
   and for $\Theta = 0^0$ and $\Theta = 2^0$ with
   electrically operated Facit calculator.

(ii) $m = 1.47 - ik$ for $k = 0.1 \ (0.1) \ to \ 0.5$
    $x = 1, 3, 5, 10, 15, 20, 30, 50$ for $K = 0.5$
    and $x = 10, 20, 30, 50$ for all values of $K$.

The intensities were also calculated for $\Theta = 0^0,$
$2^0, 4^0, 6^0,$ for all the above cases.

The computations were carried out with IBM 1620.

The theoretical values of intensities obtained on the basis of Mie and Kirchhoff theory for graphite are not in good agreement. From this we conclude that through the
absolute values of intensities given by both the theories do not agree well, the forward scattering method can satisfactorily be applied to determine the particle size distribution in the systems containing small absorbing particles provided one can completely scan the broad scattering pattern in the forward direction.