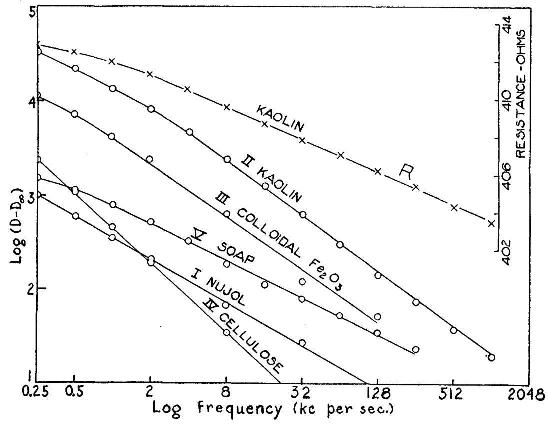

Fig. 1. Dielectric constant as a function of frequency for (I) 60 percent Nujol in 1.5 percent sodium oleate (mean diam. 5μ); (II) 45 percent kaolin in 1.5 percent sodium oleate (diam. 0.5μ); (III) 1.5 percent colloidal ferric oxide (submicroscopic); (IV) 2 percent cellulose in water; (V) 1.5 percent soap. The resistance-frequency curve is shown for 45 percent kaolin in 1.5 percent sodium oleate.

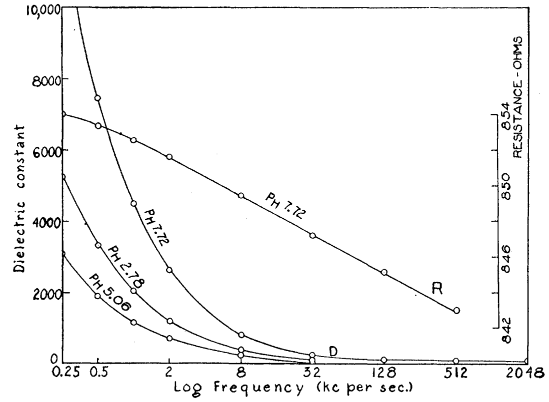

Fig. 2. The dielectric constant as a function of frequency for suspensions of kaolin in 1.5 percent gelatin at different pH values. The resistance-frequency curve is shown for one of the suspensions. Volume concentration of kaolin is 23 percent.

an inverse power of the frequency, with an exponent which is always near unity, and exactly this value in a great number of cases.

As a possible explanation of these results, it may be observed that since part of the current (representing the surface conductance) passes through the highly charged regions which are generally present at and near the surfaces of the colloidal particles, an increased dielectric constant and resistance would result at the lower frequencies if the current, in passing into such regions, were polarized as one would expect it to be. From the point of view of this interpretation it should be remarked that the polarization (represented by the polarization capacity and the polarization resistance), which is observed at interfaces such as metal electrodes or membranes (collodion or biological membranes) is also characterized by its being a power function of the frequency, although with widely varying values of the exponent from system to system.[7, 8]

The experiments represented in Fig. 2 were made to test the relation of the increased dielectric constant to the charge on the colloidal particles. Suspensions of kaolin in gelatin were measured at three different pH values. At $pH=5.0$, which is close to the isoelectric point of gelatin, the electrophoretic velocity of the kaolin particles is nearly zero and the dielectric constant smallest. That the value is still high may be explained on the grounds that the zero charge on a kaolin particle, at the isoelectric point, results from a time or space average of equal positive and negative charges.

Other systems studied include colloidal ferric oxide,[9] soap (commercial), sodium oleate, gum arabic and gelatin. For ferric oxide and soap (1.5 percent) the frequency curves for resistance and dielectric constant present the same general forms as those obtained for coarser suspensions (Fig. 1). For sodium oleate (1.5 percent) as well as for gum arabic (10 percent) and gelatin (1.5 percent), the resistance and dielectric constant are independent of the frequency.

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Welding Arcs in Argon

The purpose of this note is to give an interpretation to some experiments with arcs in argon recently reported in these columns by G. E. Doan and W. C. Schulte.[1] They found that in pure argon gas there is "a complete absence of crater formation in the base metal or previous weld deposit, and a resulting complete lack of penetration into, and fusion of the parts being welded." This was observed at values of total arc wattage equal to or greater than that required to produce satisfactory welds in air.

The relatively poor heat transfer due to the lack of a dissociation-diffusion-recombination process in the monatomic argon is probably responsible for these results. By a variation of the velocity of sound method previously reported,[2] we have measured the gas column temperature in a welding arc between an iron plate and a 3/16″ commercial coated iron welding rod (type W-20) at 125 amperes d.c. and find a mean value of 6000°K. From recently determined[3] equilibrium constants for the dissociation processes $O_2\rightleftarrows 2O$, $N_2\rightleftarrows 2N$, the arc atmosphere is calculated to be 81 percent atomic gas at the observed temperature. The effectiveness of dissociated gas in heating metallic surfaces, which act as catalysts for the recombination process, is well known. Langmuir[4] has shown that for the H_2 arc the alternative process, direct thermal conduction through the gas, is relatively unimportant. The high percentage of atomic gas which we have observed in welding arcs suggests that these arcs depend to a large extent upon the diffusion-recombination process for heat transfer. The experimental results of Doan and Schulte support this view.

The relative effectiveness of the diffusion of H through H_2 and N through N_2 in heat transfer may be calculated from

$$h_H/h_N = aD_H V_H/aD_N V_N = \lambda_H C_H V_H/\lambda_N C_N V_N,$$

where h is the quantity of heat, a is a constant, D is the diffusion coefficient, V is the dissociation potential, C is the mean molecular velocity, λ is the m.f.p., and the subscripts refer to the respective gases. With the values $V_H = 4.4$ and $V_N = 11.7$, $h_H/h_N = 2.6$. Thus for the same degree of dissociation the diffusion heat transfer in nitrogen is nearly half as effective as in hydrogen.

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