

5. Study on Surface Electricity. (VI)

On U-Effect.

Shizuo Ueda, Fukuji Tsuji and Akira Watanabe.

When we disturb the electrical double layer in a glass capillary by a vibrating source like sonic or supersonic wave, we find the generation of an alternating voltage of the same wave character (wave form and frequency etc.) at the two ends of the capillary. We call this U-effect. We proved this experimentally in two cases; glass-dil. salt solution interfaces and sulphuric acid-mercury interfaces. As the vibrating source, we applied always sonic or supersonic wave of sine wave form, and observed the potential generated with cathode ray oscillograph set. We got quite sufficient results to fulfil this condition.

The theoretical treatise of this is as follows. In case of the electrical double layer of glass-electrolyte solution interface, we apply Helmholtz's formula and consider the pressure P to be periodical function of time. This leads to the periodical change of streaming potential E . In case of sulphuric acid-mercury interface we consider this interface as an ideal polarized electrode, and the alternating voltage occurs in compliance with the periodical change of the interface area s . That is, when we put $s=s_0 e^{i\omega t}$ and the electrical density of the interface σ , the electrical quantity at the interface is given by $q=\sigma s_0 e^{i\omega t}$.

As the application of U-effect we have almost accomplished the device of pick-up of electrophone and microphone. It was also clarified that the fish locator applied with this device is as effective as that with Rochelle salt, and that this effect can be applied with as good result, as with the Rochelle salt for the point of conversion devices from mechanical energy of vibration to electrical energy, such as that of cardiograph, stethoscope and mouthpiece of telephone etc.

6. Study on Surface Electricity. (VII)

Measurement of Streaming Potential by Vibration Method.

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When fluid is forced by pressure through a diaphragm or capillary an electromotive force, so called "streaming potential", is generated. Up to the present constant pressure has been used and the streaming potential has been measured by electrostatic method. But we used periodically changing pressure, e.g. simple harmonic motion of moving coil, and succeeded in measuring the potential as an alternating voltage. Applying this method, we first measured the streaming poten-

tial of various salt solutions (KCl, KI, $K_4Fe(CN)_6$, etc.) at various concentrations (from 10^{-2} to 10^{-7} norm.). Seeing the change of the potential generated by various salt solutions of different concentration at constant amplitude of vibration, it was proved that the more dilute the solution is, the larger the potential is. The potential-concentration curve gave a considerable parallelism with the results given by Lachs and Biczuk [Z. physik. Chem., **148**, 441 (1930)] measured by ordinary electrostatic method. We measured secondly the change of electromotive force with the amplitude of vibration at 10^{-5} norm. KCl aq. solution and 10^{-5} norm. KCl 10% alcoholic aq. solution, and compared it with Ettisch and Zwanzig's results [Z. physik. Chem., **160**, 385 (1932)]. Contrary to their results, we got a linear relation between them in both cases. This means that the electrokinetic potential is independent of the pressure.

We are performing more detailed experiments. Its theoretical treatise shall be reported next time.

7. Study on Powder Explosion. (IV)

The Relation between Inflammability and Volatile Matter of Coal,
and the Influence of Additional.

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For the purpose of preventing dust explosion which takes place frequently in a coal mine, we examined the relation between inflammability and volatile matter of coal and the influence of additional by the dispersion method (This report, **15**, 41 (1946); **18**, 120 (1949); Science of powder, **2**, 88 (1948)). 23 kinds of coal which were different from each other in volatile matter (4.75%-43.5%) were examined. The lower the volatile matter, the lower was the inflammability, and below 27.27% it was unflammable. When 6% or 9.9% of the volatile matter was removed from "Iwaki" coal, the inflammability decreased accurately.

5%-60% of SiO_2 , Al_2O_3 and $CaCO_3$ (crushed marble and precipitated calcium carbonate) were added to "Iwaki" coal. Precipitated calcium carbonate indicated the remarkable control of inflammability, while marble showed the repressive action compared with others, and with an increase of the amount of additional, the inflammation became difficult and stopped with 40% of precipitated calcium carbonate, 45% of marble and 50% of silica and alumina. The smaller the size of the additional, the larger was the repression action.

In regard to the remarkable repressive action of the precipitated calcium carbonate, the mixed state was observed by the microscope and found that the coal dust particles were covered with precipitated calcium carbonate particles of the smaller