method, and the results are shown in Table 1.

Table 1.

Peptiser	Most effective concentration	Specific sediment. volume	Average particle size	Viscosity of the suspension
$(NaPO_3)_6$	0.3 %	1.6 cc/g	2.4 μ	0.14 g./cm. sec
$(KPO_3)_4$	0.2	1.7	2.4	0.22
Water glass	0.5	1.8	2.4	——
$Na_4P_2O_7 \cdot 10H_2O$	0.01 mol	2.0	2.9	0.22
$Na_2C_4H_4O \cdot 2H_2O$	0.01	2.2	3.4	0.25
$Na_3PO_4 \cdot 10H_2O$	0.01	2.4	3.8	0.29
$Na_3C_6H_5O_7 \cdot 5H_2O$	0.1	3.0	3.8	0.49
NaCl	0.1	3.1	3.8	0.64
NaOH	0.1	3.2	4.1	0.70

The particle size distribution of the calcium carbonate powders in the various electrolytic solution at the concentration of minimum sedimentation volume were measured with Suito and Arakawa's Sedimentograph (This Bull. 22, 7 (1950) and Wiegner's apparatus. The average particle size calculated from the size distribution curves is shown in Table 1.

On the other hand the viscosity of the suspension were measured with Stomer viscosimeter. The viscosity was the smallest at the concentration of the electrolyte at minimum final sedimentation volumes. The specific viscosity of various electrolytes at the minimum final sedimentation volume is shown in Table 1.

Among the final sedimentation volumes, the average particle size and the viscosity of the suspensions are in parallel to each other, as is summarized in Table 1. Because in the suspension of aggregate particles (average particle size is large) there are involved many voids in the final sedimentation state, it would be considered that the sedimentation volume becomes bulky and the viscosity is increased owing to the mutual action among the aggregated particles.

From the results mentioned above it becomes clear that, Hofmeister's series can be applied to the dispersion power of the electrolytes, the most effective peptiser being Na-hexametaphosphate of 0.3 % concentration.

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6. Sedimentation Analysis of Powders. (IV)

Dispersion Agents for Cement Powder

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In cement industry, one of the important application of sedimentation analysis, is the determination of particle size distribution of powders. Generally Kerosene is used as a dispersion medium, but the results of sedimentation analysis varies with the dispersion agents owing to their dispersing power. For this purpose, the following various surface active agents were added in the Kerosene suspension of the cement powders and measured its dispersing power. 1. Oleic acid. 2. Petrobase 1B. (Petroleum sulfonates, plus secondary emulsifier) 3. Terposol No. 8 (mainly Terpinyl ethylene glycol ether) 4. SA-5 and SA-6 (Alkyl naphtalene sulfonate). The apparatus for the sedimentation analysis used was Sedimentograph Model-II which is newly constructed at Shimadzu Co. under the authors direction (This Bull. **22**, 7-17 (1950)).

The relation between the concentration of oleic acid and specific surface area which are calculated from particle size distribution curves obtained with the same sample of cement powder under various concentration of oleic acid is shown in Fig. 1. The most effective concentration of oleic acid was 0.005-0.008 mol.

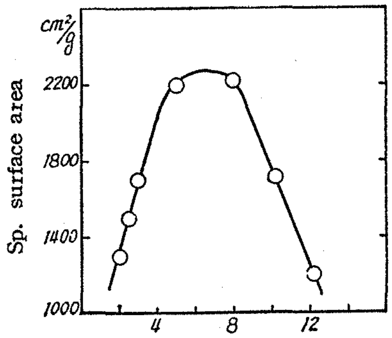

Fig. 1.

By the same manner, the most effective concentrations of the other dispersion agents were determined, and the values of specific surface area calculated at that concentration are shown in Table 1. Therefore, Petrobase 1B was the most effective

Table 1.

Dispersion agent	Petrobase 1B (0.2%)	Oleic acid (0.006 mol)	SA-6 (1 %)	SA-5 (0.8 %)	Terposol No. 8
Sp. Surface Area cm²/g.	1782	1626	1610	1165	—

dispersion agents. The value of specific surface area was increased with the time of standing after the suspension prepared, but changed no more after a day. Accordingly, the actual measurements were done in the most effective condition, *i.e.* using 0.2 % solution of Petrobase 1B and after standing a day. With various samples of cement powders, the curves of particles size distribution obtained had 2 or 3 maximums that is commonly peculiar to powders crushed by ball mill or tube mill, and howed that the 2-40 μ particles formed 70-80 %, of which 4-6 μ had the majority.

The results obtained for 101 B and 101 C (standard sample for Blaine's permeability method) is compared with air sieve method as shown in Table 2. It shows that

Table 2.

Sample	Method	40 μ	40—30 μ	30—20 μ	20—15 μ	15 μ
101 B	Sed.	15.5 %	15.5 %	8.2 %	9.7 %	51.8 %
	Air.	30.1	11.2	16.2	8.1	34.6
101 C	Sed.	19.5	20.1	13.1	10.6	36.7
	Air.	35.3	12.4	13.4	7.2	33.5

the dispersion is insufficient and the particles are much aggregated by the air sieve method. The value of specific surface area calculated from the particle size distribution curves of various cement samples are shwon in Table 3 along with those measured by other methods.

Table 3.

Sample	Sedimentation		Blaine's permeability		Adsorption	
	Sp. Area cm²/g.	Relative value	Sp. Area cm²/g.	Relative value	Sp. Area cm²/g.	Relative value
No. 3	2384	1.28	3351	1.09	17,800	1.17
No. 10	2210	1.18	—	—	—	—
101 B	1861	1.00	3050	1.00	15,200	1.00
No. 2	1781	0.95	2705	0.88	12,400	0.81
No. 1	1731	0.93	2734	0.89	11,400	0.75
101 C	1670	0.89	2572	0.84	10,600	0.69
No. 4	1625	0.87	2451	0.80	9,600	0.63

The values of the same sample are different according to the measuring methods, because of the difference of principle of measurement. The relative values of specific surface area of each samples, which were calculated 101 B as standard, agree well with each other. The effect of these dispersion agents is seemed due to its adsorption on the surface of particles of cement powders.