RECUEIL DES TRAVAUX CHIMIQUES DES PAYS-BAS
publ. par la Soc. chim. néerl. [den Haag (Hollande), W. Witsenplein 6]
T. 60, 5 (mai 1941).
Soc. anon. d'éditions scientifiques D. B. CENTEN, Amsterdam.

541.182.6 : 668.393.51 : 541.183.613

THE BEHAVIOUR OF AGAR SOL TOWARDS A RED GOLD SOL

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The gold number of agar has been determined, at which the protective action of agar could be made visible. The presence in agar of a gel-forming component and a component which does not form a gel could be demonstrated.

From many investigations it is known that lyophilic colloids show a protective action on lyophobic sols. As a measure of the protective action Zsigmondy introduced the gold number, i. e. the minimum quantity in milligrams of the lyophilic colloid which prevents the coagulation of 10 cm³ of a red gold sol by 1 cm³ of a solution of 10 % sodium chloride.

The explanation of the protective action is based on the assumption that the micelles of the lyophilic colloid envelop the gold particles which therefore become less sensitive for coagulation by electrolytes. From measurements of the cataphoretic velocity of, for example, quartz particles in protein solution it appeared that the quartz particles behave as protein micelles. Evidently the quartz particles are coated with a layer of protein.

However, it has never been proved experimentally that a lyophilic colloid actually does envelop the particles of a lyophobic sol. It may therefore be of interest to describe a simple experiment.

A red gold sol was prepared in the following way:

To 500 cm³ boiling conductivity water were added 10 cm³ gold chloride solution 0.1 %. 10 cm³ of a mixture of 90 cm³ potassium carbonate 0.2 n and 10 cm³ formaldehyde 35 % were then added.

The reduction sets in immediately. The sol is then boiled for one hour.

Agar, washed with distilled water for two days and dried, was dissolved in distilled water so as to make a 1 % solution, which was filtered when hot.

Into well steamed glass tubes 10 cm³ of the gold sol were pipetted. The tubes were placed in a water-bath of 50° C and 1 cm³ of agar sol of decreasing concentration was added. After mixing 1 cm³ of a solution of 10 % sodium chloride was added, while stirring. Table I shows the results.

Table I.

1 mg agar added to 10 cm³ gold sol	2 Colour of the mixture after 10 minutes	3 Colour of the mixture after cooling
10	red	red flocks, liquid colourless
5	"	" " " "
2.5	"	" " " "
1.3	"	" " " "
0.65	"	" " " red
0.32	"	" " " red
0.16	violet	no flocks " violet
0.08	blue	no flocks " blue
0,04	blue	blue precipitate, liquid colourless

From these results it follows that the gold number of agar is 0.32. On cooling gel flocks appear in the mixtures (cf. column 3 of table I). The flocks were red, indicating that the gold particles were inclosed in them; on re-heating a red gold sol was formed.

These red flocks could also be obtained without addition of sodium chloride and with decreasing amounts of agar. The red flocks are therefore gold particles coated with agar.

On addition of 0.65 or 0.32 mg agar the supernatant liquid was red. This means that a part of the gold particles are coated with a protecting lyophilic component of agar which does not form gel flocks. In other words the agar concentration is high enough to protect the gold sol from being coagulated, but still so low that there is not enough of the gel-forming component to remove all the gold particles in gel flocks. On increasing the amount of agar to 1.3 mg, all the particles appear in the flocks and the liquid is colourless.

The presence of organic material in the red liquid was shown by drying and ignition.

Wageningen, *Agricultural College Laboratory for physical- and colloid chemistry*, March 1941.

(Received March 10th 1941).