

Purification of Colloidal Silica

(Extracted from the Diaion Manuals pages 251 to 252)

13. Purification of Colloidal Silica: Silica Gel

Colloidal silica is used as a specular polishing agent of silicon wafers, a binder of ceramic fibers and luminophors, a gelation agent of battery electrolytes and others. It is manufactured by the electro dialysis, the electrolysis and the ion-exchange process. There are used to adjust the pH and the concentration ($\text{SiO}_2 \cdot \text{Na}_2\text{O} \cdot \text{H}_2\text{O}$ ratio) of anhydrous silicic acid in

sol-form that is made from silicates, mainly from alkali metal silicates, by specified purification.

Silicate solutions of low concentration are generally stable and thus are easily treated by IERs. Since the operation cost of concentration is high, IER treatment of high concentration solutions are increasing in recent years. The IERs used to remove sodium are in H-form of SACERs or WACERs. Patents are summarized as follows:

(i) Application of SACERs

- Sodium silicate ($\text{SiO}_2/\text{Na}_2\text{O} = 3.1$) is diluted with water and treated with SACER, H-form SK1B, and 5% silicic acid is obtained.
- Add 35% HCl solution to the 5% silicic acid and heat them at 95 °C for an hour, and acidic silicic acid colloidal solution of pH 0 is obtained.
- Treat the solution with UF membranes the molecular weight cut off of which is 6,000, and oligo-silicic acid solution of 2 μm average diameter and with impurities of 23mg- SiO_2/L is formulated.
- Treat the solution with mixed bed system of SK1B and SA10A till the impurities become below 6 mg- SiO_2/L .
- Add ammonia water, and concentrate until 20% conc. of silica
- The average particle diameter of the final silica sol is 13.6 μm and its impurities conc. is 8mg- SiO_2/L .⁽⁶²⁾

(ii) Application of WACERs

Alkaline silicic acid solution of 7.7% silicic acid that is diluted from sodium silicate solution ($\text{SiO}_2/\text{Na}_2\text{O} = 3.15$) is then treated by electro dialysis, with RO membranes and finally with WACER, WK40.⁽⁶³⁾ Table VII-13-1 summarizes the properties of these procedures.

[Table VII-13-1] Silica gel manufacturing with WACERs⁽⁶³⁾

	Raw material	Dilution water	After E/D	After RO	After WK40
Specific gravity (15 °C)	1.404		1.060	1.121	
SiO_2 (%)	28.12	7.7	8.03	16.3	16.23
Na_2O (%)	9.21		0.78	1.45	
$\text{SiO}_2/\text{Na}_2\text{O}$	3.15		10.62	11.60	28.88