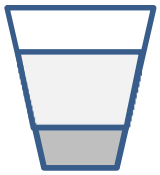
Application Note – Colloid Analysis

Colloidal Alumina: Stability Statement by Zeta Potential doubtful

Dispersing alumina particles hardly possible

In an acid solution an alumina suspension is stable. **IS THAT RIGHT?** – Yes, but only partly. How was the question raised? After dispersing alumina in water of different pH the dispersion was settling in most cases. Surprisingly, this happened already at pH values above 4.2. The dispersion was sonicated for 4 minutes at 200 W.

pH > 4



pH = 3.5

Behavior of the suspension clarified by double titration

Consequently, only a systematic titration could reveal the behaviour. The preparation of the sample was the same as before with the difference that the starting point was at pH 3 in the first case, in the second at pH 7.2. The titration was programmed in opposite pH direction. As sedimentation was so unpredictable, the size was followed simultaneously with the zeta potential titration. When it comes to judge, whether the stability of a dispersion is acceptable or not, ultimately the size gives a valid credit.

The figures below show the simultaneous measurements of the particle charge and particle size in the Stabino® particle charge titration system. 1) from pH = 3 up, and 2) from pH = 7.2 down. In Fig. 1 the sample was diluted with a pH = 3 solution. The suspension took on a value of pH = 3.5 and a zeta potential value of 45 mV. The particle size, which was simultaneously measured with the NANO-flex® dip-in probe, showed 450 nm and remained stable until reaching a pH of 6.8. Thereafter, the particle size jumped up to 1300 nm..

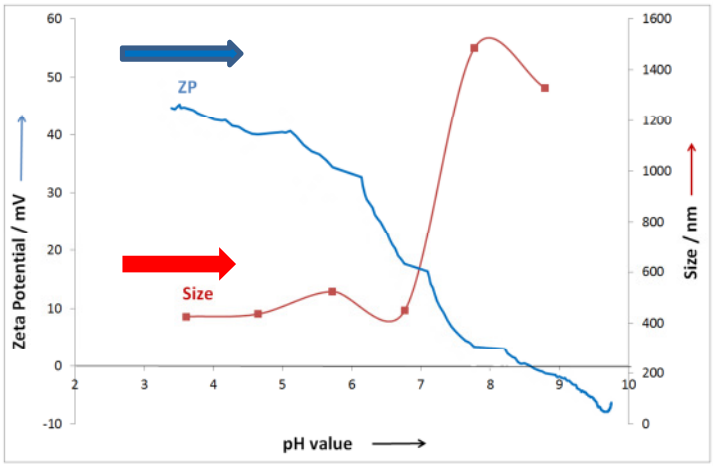


Fig. 1: pH titration of a 1% Al_2O_3 dispersion in the Particle Metrix Stabino® Particle Charge Titrator. Starting at pH 3.5. Simultaneous recording of zeta potential (quasi continuous curve in blue) and and dip-in NANO-flex® DLS size probe (red points). The direction of titration is marked by arrows.

Conclusion: After having dispersed the powder at pH 3, the suspension stays stable below pH 6.8.

ATTENTION! If the suspension was once destabilized by a higher pH value, there is no trick to return into the stable phase. This is shown in Fig. 2.

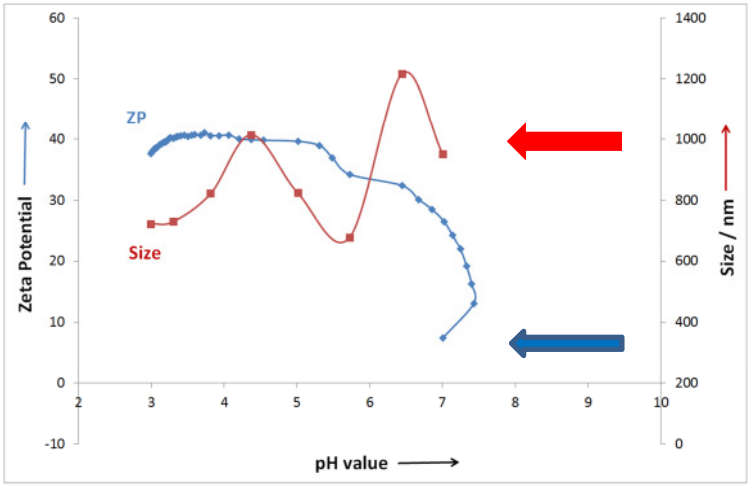


Fig. 2: Start of the titration of the same alumina sample dispersed in water at pH 7.50 into the acid. The direction of titration is marked by arrows. Size values in red, zeta potential quasi continuous in blue.

In the beginning, the particle size fluctuates strongly around 1000 nm. At the end at pH 3.5 it falls back to 730 nm but not to the measured value of 450 nm shown in Fig. 1. And that, DESPITE the zeta potential rises to the same level of 42 mV. From the usual view of the zeta potential value of 42 mV one is tempted to say, that because of the high zeta potential the sample has again become stable. BUT IT IS NOT as the size values show.

Conclusion: In this case, the Particle Size is the better Stability Parameter

In the particular case the zeta potential is not worth a stability statement. To get better knowledge of the sample, the pH vs size titration in both directions is recommended. Concomitant titration of the zeta potential is easy and therefore does no harm. Apart from that, a titration with the Particle Metrix Stabino® is outstandingly fast and highly versatile in application.

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