

How to Utilize Zeta Potential to Stabilize Pharmaceutical Suspensions

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Zeta potential measures the stability of a suspension and is often used as a method of quality control in many common place pharmaceutical products. As the absolute value of zeta potential gets closer to 0mV, the suspension becomes less stable. Low zeta potential in an unstable suspension indicates that the particles in the suspension are likely to be attracted to each other and form flocculants or agglomerate, and possibly settle out of the medium in lumps. In finished products like vaccines, cough syrups, and other liquid medicines, as well as in-process suspensions like time-release spray suspensions for bead or tablet coatings, it's crucial to have the right zeta potential to ensure the proper dispersion of the formulation components.

Some time-release drugs are made through spraying a suspension which contains the actual drug over small sugar spheres or beads. The suspension must have an appropriate zeta potential, along with other processing parameters, to avoid clumping up the sprayer and the uneven distribution of the drug. In the body, these sugar beads are encapsulated and the drug suspension is released at different time intervals. Many liquid medicines come with the instructions "shake well before use." Settling or uncontrolled flocculation in these medicines can be due to low zeta potential which may cause the components of the suspension to clump together and may be due to inappropriate formulation components being used. If the zeta potential of these substances can be adjusted, a more uniformly spread suspension can be made. With other types of pharmaceutical products, uniformity of the suspension needs

to be controlled and confirmed before allowing them on the market. Therefore, measuring a correct and appropriate zeta potential value is one of the keys to a quality product. So how exactly do we get the best measurement for zeta potential?

There are many factors that can impede the accurate measurement of the zeta potential of suspensions. Zeta potential is measured by ELS (Electrophoretic Light Scattering) where the result is a mobility value for the particles in suspension as they move in response to an electric field. The mobility value is then used to calculate zeta potential. When measuring zeta potential, a common problem is that the electrodes are far apart, thus requiring a large amount of energy to generate an electric field. This can generate heat at the electrodes' surfaces when an electric field is applied. The heat generation can damage temperature-sensitive materials, such as denaturing protein components of a suspension. It is especially important to prevent this issue when making vaccines where the antibodies can be damaged. To avoid this complication, it's best to have electrodes that are parallel and close together to minimize the amount of energy needed to create the same electric field and reducing the possibility of the heat damage.

To increase the accuracy of a zeta potential determination, an ELS analyzer should measure mobility at various points within a suspension instead of only one point. The primary reason is that it is possible for the mobility to vary slightly at different points in a sample cell. Various points in the suspension should be assessed because the electroosmosis effect can hinder the mobility of particles in the suspension. The multi-point measurements also help account for the possible surface charge of the cell which could further hinder mobility of particles close to this surface.

Since zeta potential is an indicator of the suspension quality of various pharmaceutical products, measurement of zeta potential to yield the best products is of primary importance during product development. With instruments that can control possible sources of error or inaccuracy, zeta potential can be determined and used to your advantage.