Using Zeta Potential to Calibrate a Streaming Current Device

Zeta Potential Controls Coagulation

Zeta potential is an excellent tool for coagulant dosage control and we are proud to have pioneered its use in water treatment over 40 years ago. Operation of a zeta-meter is simple and the results are in real units - milliVolts (mV).

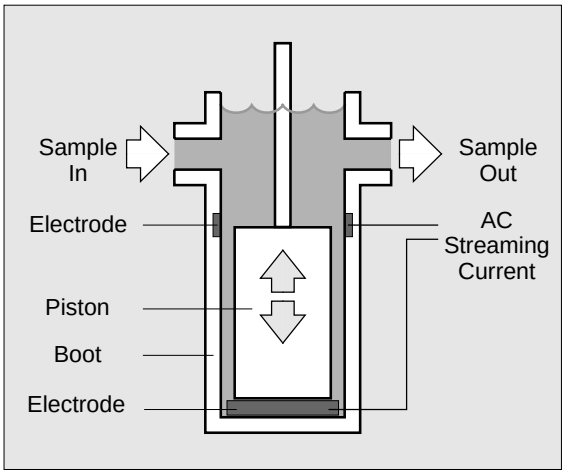
A video display or microscope is used to view particles inside a sample cell. A voltage field is then applied and particles are tracked as they move with a speed and direction that is related to their zeta potential. Tracking involves pressing a button and holding it down while a particle traverses a grid. When the track button is released the zeta-meter instantly calculates and displays the zeta potential. A single tracking takes a few seconds, and a complete run takes only minutes.

The zeta potential that corresponds to optimum coagulation will usually be between 0mV and -5mV, but a specific target value is best established by correlation with actual plant performance.

Once a target value is set, routine control is simple and merely involves measuring the zeta potential of a sample after the flash mix. If the zeta potential is more negative than the target value, just increase the primary coagulant dose. If it is more positive, then lower it.

Streaming Current - On-Line Zeta-Potential ... Almost

The streaming current device was developed because the zeta-meter is not an on-line instrument. Streaming current is the electrical current created when water is forced through a tube. It is proportional to the zeta potential of the walls of the tube, not the particles or flocs in the water. But fortunately, particles adhere loosely to the walls and affect its zeta potential. As a result, streaming current is an indirect measurement of particle zeta potential.



Streaming Current Detector
In most commercial devices a piston travels up and down inside a cylinder, causing the sample to flow up and down through the space between them and creating an alternating (AC) current. The AC current is electrically amplified and conditioned to produce the streaming current signal.

Since it is indirect, an unadjusted streaming current display has no physical meaning. A change only indicates that something is different but does not indicate the importance of the change.

For instance, a change of 5 streaming current units does not correspond to 5 zeta potential units. It could equal 0.2mV which is insignificant, or 10mV indicating a very real problem.

In addition, the response of a streaming current device can vary due to slight changes in the piston diameter.

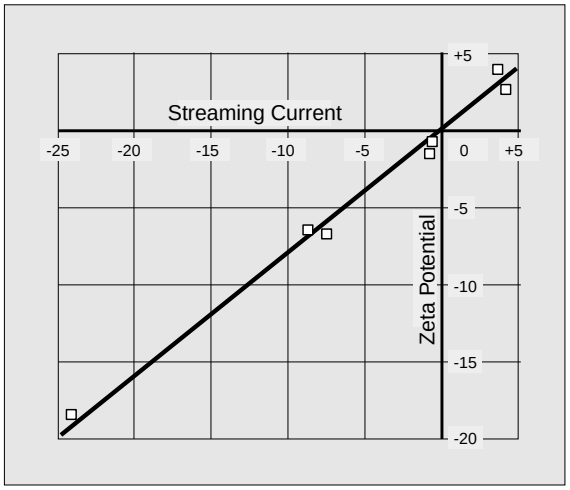
As a result, uncalibrated streaming current values can be very misleading.

Smart Streaming Current

The smart solution is to combine the best features of zeta potential and streaming current. In other words, to calibrate the streaming current display to read in zeta potential units instead of meaningless "SCU's" (streaming current units). This involves essentially two adjustments: first to the offset and then to the gain. In each case, take a zeta potential sample directly from the discharge of the streaming current device.

The easiest way to set the offset is to slowly adjust the flocculant dose until the zeta potential is zero. At that point, use the zero (or offset) control to set the streaming current display to "0.00".

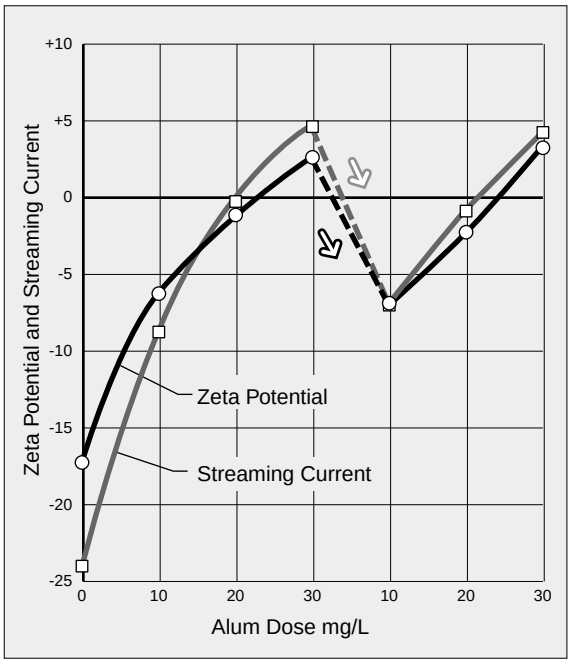
Next, reduce the coagulant dose in small steps and monitor the zeta potential. When it reaches about -3mV or -5mV adjust the gain on the streaming current monitor until the display reading matches the measured zeta potential.



Calibration
In this example an artificial water sample was prepared with 50 mg/L of kaolin clay for turbidity. The offset and gain controls of the streaming current device were adjusted based on zeta potential measurements. Later the calibration was tested at several points. The relation is linear, but the gain could have been set more carefully.

Adjusting the gain may affect the zero adjustment so repeat the procedure during the first calibration and note whether the two are interrelated.

After this, it is probably sufficient to measure zeta potential once daily to check the streaming current display. Recalibrate weekly or monthly based on experience.



Response to Alum Dose
After calibration, the artificial water was treated with varying dosages of alum. The zeta potential and streaming current follow each other in a reasonable fashion.

If you try this technique, please let us know about your experience. We appreciate your suggestions.

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