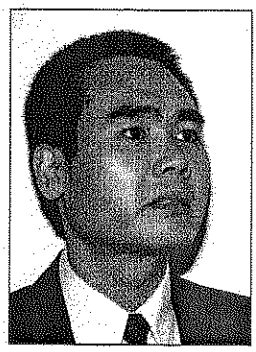
field report

BY JUNLI WANG

Finding the optimal flocculation point with a streaming potential instrument

STREAMING CURRENT INSTRUMENTS HAVE BEEN USED TO CONTROL FLOCCULATION IN DRINKING WATER AND WASTEWATER TREATMENT FOR MANY YEARS.



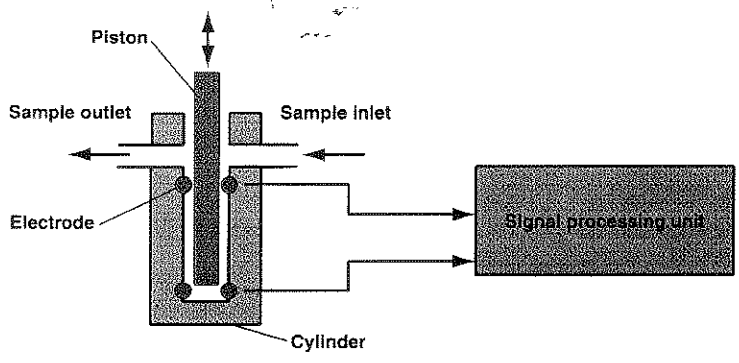
Wang

Once the optimal operating conditions are determined through laboratory tests or trial and error, the streaming current instrument can be used to maintain them by monitoring the change of the charge density of the suspended particles. Unfortunately, these instruments have not been useful for determining the optimal operating conditions because they cannot find the neutral charge point, which is in theory the optimal chemical dosage point.

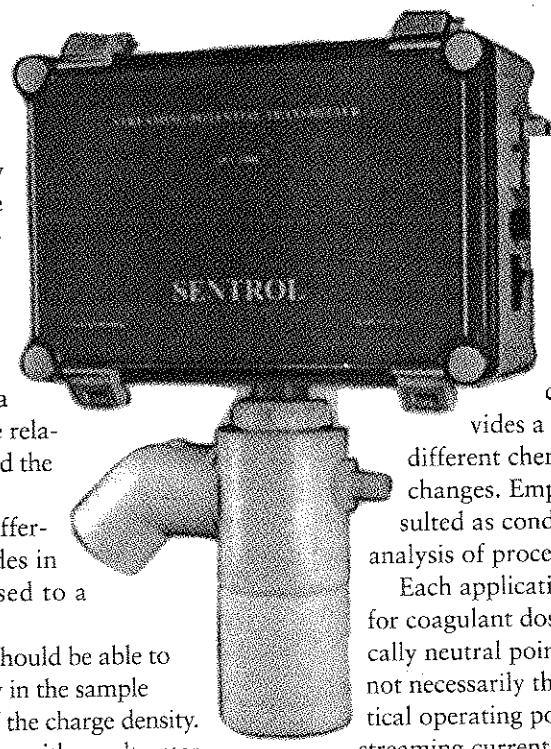
For example, if you were to take a bucket of water from the river, you could measure its pH level. You would then have a starting point for adjusting the pH to the desired level. The same would be true for temperature, conductivity, and so forth. Ideally, you should be able to measure the net charge density of the water as well, providing a starting point for adjusting it for optimal flocculation. However, traditional streaming current instruments can

Sentrol Systems offers a streaming potential detector (above) and a streaming potential transmitter (right).

FIGURE 1 Streaming current measurement technique



only measure the relative change of the charge density in the water; they cannot determine the neutral charge point, which is the baseline measurement for chemical optimization.



STREAMING CURRENT TECHNIQUE

In a streaming current instrument, water is forced through by a piston in the cylinder (Figure 1). The relative movement between the piston and the cylinder walls generates a charged stream, which creates a potential difference (voltage) between the electrodes in the cylinder. The signal is processed to a streaming potential signal.

The streaming current technique should be able to measure the actual net charge density in the sample water, not only the relative change of the charge density. This is the same as measuring voltage with a voltmeter, which measures voltage magnitude as well as its polarity. For the same reason, the streaming current instrument should be able to measure the net charge magnitude and polarity. If the water being tested is negatively charged, a streaming current instrument should indicate the negative polarity as well as the magnitude on a linear scale. The same instrument should indicate a positive signal for positively charged water. When water is electrically neutral (positive and negative charges are exactly balanced), the instrument should indicate the value of zero. Figure 2 describes a streaming current instrument measurement for water samples with different charge distributions.

INSTRUMENT SHOULD DETERMINE NEUTRAL CHARGE POINT AND CHANGE IN CHARGE DENSITY

Ideally, a streaming current instrument should be capable of determining the neutral charge point as well as the change in charge density on a linear scale. This provides a starting point for chemical optimization and also provides a baseline for comparing results from different chemicals, water sources, and seasonal changes. Empirical data can be stored and consulted as conditions change, allowing scientific analysis of process conditions.

Each application is unique, as are the requirements for coagulant dosage optimization. Although the electrically neutral point is theoretically the optimal point, it is not necessarily the desired operating point (i.e., the practical operating point) for all applications. Traditional streaming current instruments are usually "zeroed" once a desired operating point has been determined, but they cannot be used to find the neutral charge point.

For a streaming current instrument to determine both the theoretical and the practical operating point, it must be able to output two signals. One signal measures the net charge density with charge polarity and magnitude, in which the zero point is the neutral point. The other signal should be adjustable, allowing an artificial zero point adjustment depending on the individual application. Although the former is the more scientific approach, years of practice in setting the zero point of a streaming current signal to the practical operating point have become old habit.

NEW INSTRUMENT PROVIDES TWO MEASUREMENT SIGNALS

Sentrol Systems has developed an online streaming potential instrument, the streaming potential system (SPS), which

TABLE 1 Data collected at Crooked Creek Water Reclamation Facility

SPS* Signal	Cake *% total solids*	Polymer Dose *gpm (L/s)*
–0.033	13.53	3.00 (0.18)
–0.023	15.90	3.30 (0.20)
0.000	17.33	3.80 (0.23)
0.008	17.12	4.30 (0.27)
0.010	16.23	4.60 (0.29)
0.013	16.21	5.00 (0.31)
0.015	16.18	5.30 (0.33)
0.020	15.48	5.60 (0.35)

*SPS—streaming potential system

FIGURE 2 Charge distributions versus streaming current value

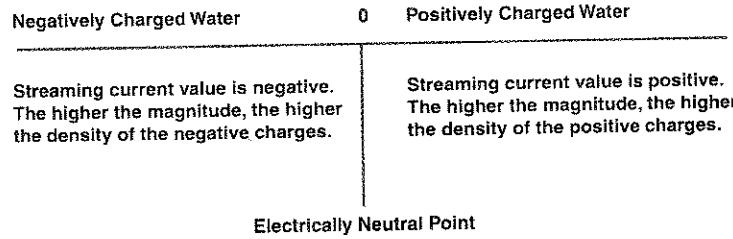
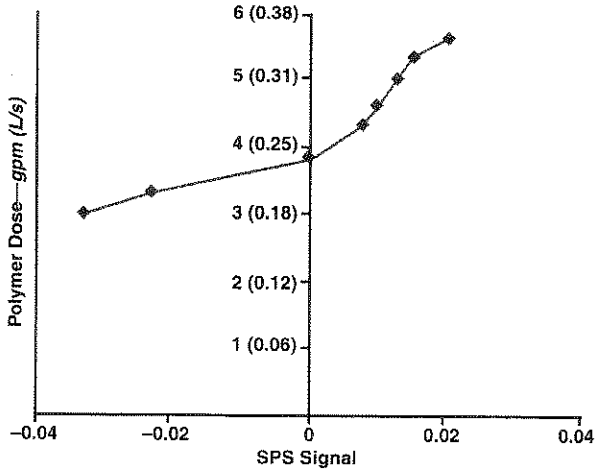
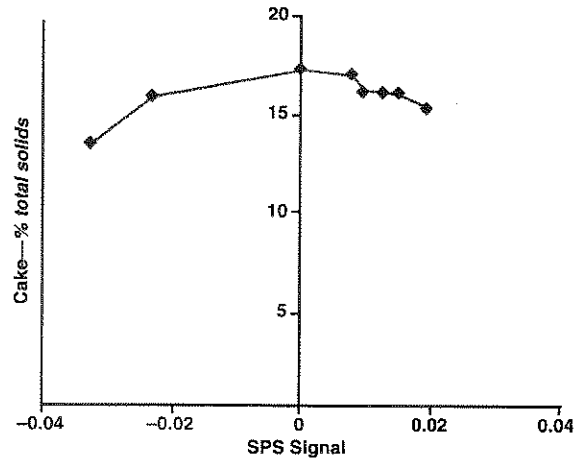


FIGURE 3 Relationship between the SPS signal and polymer dosage



SPS—streaming potential system

FIGURE 4 Relationship between the SPS signal and cake dryness



SPS—streaming potential system

provides two measurement signals—an absolute signal and a relative operating signal.

The absolute signal measures the net charge density with charge polarity and magnitude, in which the neutral charge point is always displayed as zero. The relative signal is adjustable so that the zero point can be set to the desired operating point.

Operators can use the absolute signal to determine the theoretical operating point. The relative signal is used when the desired operating point is different from the theoretical point.

An SPS was installed at Crooked Creek Water Reclamation Facility in Norcross, Ga., in July 1998. This online instrument was used to monitor centrate charge. Table 1 lists the processing sampling data collected at Crooked Creek. Figure 3 shows the strong relationship between the SPS signal and polymer dosage. Figure 4 shows the relationship between the SPS signal and cake dryness (% total solids). The best cake dryness occurs at the zero point of the SPS absolute signal. During this one-month trial period, the Crooked Creek plant saved approximately $3,000 in polymer costs. The SPS was designed with a nonclogging sample cylinder and will maintain normal operation in wastewater for weeks and in potable water for months without requiring maintenance.

—Junli Wang is a senior design engineer with Sentrol Systems Inc., Lilburn, Ga. He can be reached at (770) 564-1541, fax (770) 564-8605; e-mail <jlwang@mindspring.com>.