ROBERT C. KAPPEL *is regional manager of the aquatic division at ProMaqua/ProMinent USA in Pittsburgh. He has 17 years' experience in the commercial pool industry. Kappel is past co-chair of the Wisconsin HFS 172 Swimming Pool Code Revision Committee, and Executive Board chair of the Professional Pool Operators of America.*

Maintaining Control

Feel like your controller isn't giving you enough control? New technology may be the answer.

Have you ever had thoughts like these: "Why does my controller sometimes seem to add too much chemical, while other times it doesn't add enough? Why does my controller seem to be out of control? Is there a better, more predictable way of doing this?"

If so, the answer to all those questions may be PID control. Understanding that concept, and what it can do for you, can make all the difference in the control you have over your controller.

Most basically described in swimming pool terms, the letter "P" in PID stands for proportional. Proportional is the current error — the difference between the set point and the actual chemical reading in the water. The letter "I" stands for integral. Integral is the accumulation of past errors — a look back to see how often and by how much the difference between the actual readings and set points were. The letter "D" stands for derivative. Derivative is the prediction of future errors — a look forward, predicting the possibility of differences between set point and actual readings.

Most controllers can be programmed to operate in either an on/off control mode or proportional control mode. The on/off method of control is very effective at allowing the controller to reach set point quickly, but it also may overfeed chemicals due to lag time. This lag time is the bane of operators with small bodies of water and/or very irregular loading.

Proportional control mode for most of these controllers means that it utilizes only the "P" portion of PID as its control algorithm. The P algorithm will tell the chemical feed device to turn on and off for multiple specific time periods before the set point is reached. This so-called "feed-then-wait-to-see-what-happens" strategy is very effective for preventing the overfeed of chemicals. The down side is that under high organic load conditions, the controller will not be able to keep up, and chlorine levels will be continuously low and

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the pH high. Eventually, the controller will go into a feed overtime alarm and no chemicals will feed at all!

Controller manufacturers recently realized that on/off and P-only control algorithms possess shortcomings. In response to this, another control strategy was introduced: enhanced proportional control. This strategy essentially introduced PI control to the aquatics industry. The PI algorithm utilizes the P portion of PID and adds the element of I (integral), which is a look into the past performance of meeting set point.

Theoretically, PI control helps prevent overfeeds as well as underfeeds by looking at past feed events. If the controller determines that set point will not be reached before the time limit is exceeded, the feed times are automatically adjusted, and pauses are made shorter and on times longer. This seems like a perfect solution until a facility experiences multiple periods of heavy bather loading interspersed with times of inactivity. Of all bather loading scenarios, this is the hardest type for a controller to cope with and, unfortunately, it represents typical loading of many pools. It is highly likely that the controller would begin to oscillate and randomly cause underfeeds and overfeeds throughout the day. Sound familiar? This happens because when in PI control, if the controller recognizes an underfeed situation, the feed rate ramps up. This ramp-up combined with the lag time in many systems, will cause overfeed and when the controller recognizes the overfeed, it turns the feed rate down, causing an underfeed. And so the oscillations begin. How can these oscillations be prevented? Enter PID control.

Adding the D (derivative) to the PI algorithm — allowing the controller to respond with full PID control — the D value acts as a damper to keep feed oscillations to a minimum. The D value will anticipate the potential for oscillations and adjust the feed pause and feed on times accordingly. The controller now is looking at the full picture — the present (P), the past (I) and the future (D). The controller can adjust feed events to properly respond to rapidly varying bather loads and water conditions.

One additional control strategy called "adaptive control" was introduced a few years ago in an attempt to emulate full PID control. Adaptive control essentially takes a snapshot of the lag time and uses the information to predict future events. The problem is that this snapshot is done when the controller is set up and typically does not represent conditions with heavy bather loads. Thus, it is not as accurate as a continuously adjusting PID loop.

The important news for operators is that within the past few months, aquatic controller manufacturers now are offering controllers with full PID loop control. In fact, some controllers even can connect directly to a diaphragm pump, and the controller will automatically adjust the pump stroke and speed to provide additional precision to dosing!

PID control in a chemical controller can reduce costs by minimizing the potential for overfeeds and wasting of chemicals. It also can minimize operator headaches due to underfeed/overfeed oscillations, ensuring that pool water meets the required code parameters.

We are in an exciting time when savvy operators who understand the issues and know solutions are available can make a choice as to which technologies will help them solve their problems. Goodbye, under- and overfeeds! Hello, control. ■