A client had a cooling tower treated with 3005T for scale/corrosion control, sulfuric acid for pH control and bleach as a biocide. The 3005T was controlled by maintaining phosphate between 5 – 10 ppm. Suddenly, the operators saw the phosphate level shoot up to over 10 times their control range!

What could lead to such high phosphate levels in a cooling tower system? Take a few moments to consider this system diagram and what could cause this.

There are many possible causes of such a high reading. Some are obvious, but others are not so obvious. Let's approach this case study one step at a time.
Applied Chemistry

Once again, the chemistry applied to this system was:

- **3005T**: Phosphate-based scale/corrosion inhibitor containing HEDP, TT, Phosphoric Acid, TKPP and a polymer.
- **Sulfuric Acid**: pH control.
- **Bleach**: An oxidizing biocide used for microbiological control.

Possible Causes of High Phosphate Readings

- **High Cooling Tower Cycles**: Running the tower at higher cycles than desired would yield a higher phosphate residual even if the 3005T feed rate was unchanged. However, this is unlikely to result in a 10-fold increase. The tower conductivity was checked, and this was not the cause of the problem.

- **3005T Overfeed**: Increased feed of 3005T would yield higher phosphate levels. The 3005T bulk tank and pump were inspected and monitored and found to be feeding at the same rate as they had before the high phosphate residual occurred.

- **Improper Product Blend**: However unlikely, an improperly blended product is always a possibility. The vendor reported no other problems with the batch, and a dilution showed the product to have the correct phosphate level.

- **Increased Phosphate in Makeup Source**: Phosphate is frequently added to water by the city for the same reason that we add it: corrosion inhibition. If the city increased their phosphate feed and city water was the source of the tower makeup, it may result in higher phosphate readings. However, this was not the source of the problem.

- **Improper Acid Feed**: The assistant plant superintendent had a hunch as soon as he heard about the high phosphate levels. He suspected that the sulfuric acid tank had been inadvertently filled with phosphoric acid, which is used in their process. The supervisor responsible for the area insisted that this was impossible.

Conclusion

The assistant plant superintendent was certain that phosphoric acid was the being added to the tower and was causing the high phosphate readings, despite the supervisor’s protests. He obtained a sample of the acid from the tank and had it analyzed. As he expected, he found that it was phosphoric acid rather than sulfuric acid.
This was a tricky problem to figure out because everyone assumed that no one would put phosphoric acid in tank clearly marked sulfuric acid. However, mistakes like this do occur. Lessons to be learned from this include:

- Be aware of other chemicals used in the process.
- Don’t assume that the chemical in the bulk tank is always what it’s supposed to be.
- Don’t dismiss a hunch because someone else says it’s “impossible”. Always check it out yourself!