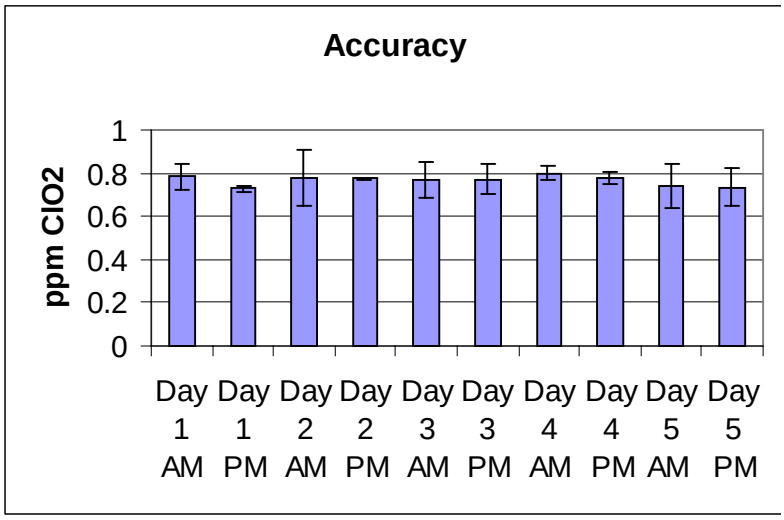
# Comprehensive Evaluation of $ClO_2$ Cell Performance

A chlorine dioxide-generating cell was subjected to a series of laboratory tests to determine the operational parameters of the ACD generator. The flow rate of the generator was set to 0.5 L/min and the concentration was set to 1.00 ppm for all testing unless otherwise specified. The concentration of chlorine dioxide produced by the generator was verified using the NCASI Spectrophotometric Method (NCASI method) described in Technical Bulletin #794.

**Precision and Accuracy Evaluation:**

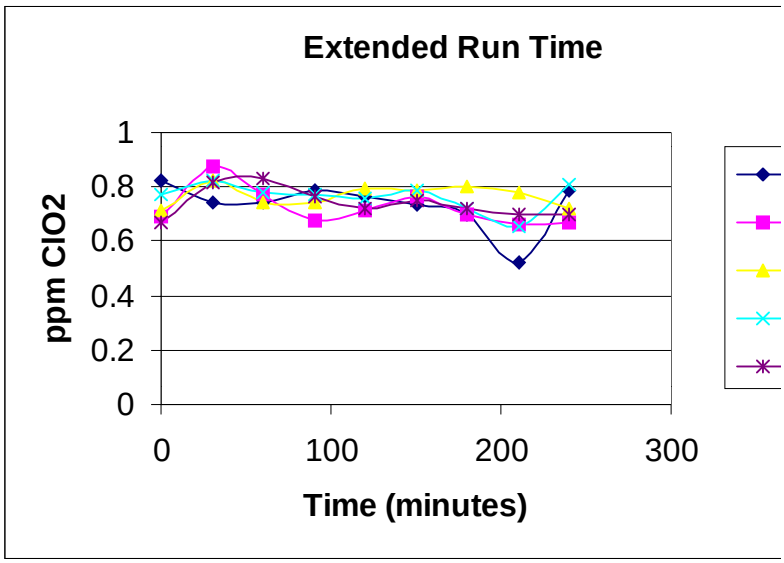
The first objective of the study was to determine the precision and accuracy of the generator when turned on twice a day over the course of a five day work week. Each morning and afternoon, the generator was turned on and chlorine dioxide output was verified using the NCASI method when the generator finished the stabilization phase and again 30 minutes after the stabilization phase ended. The mean and standard deviation of the two samples were calculated and are displayed in the figure on the left.



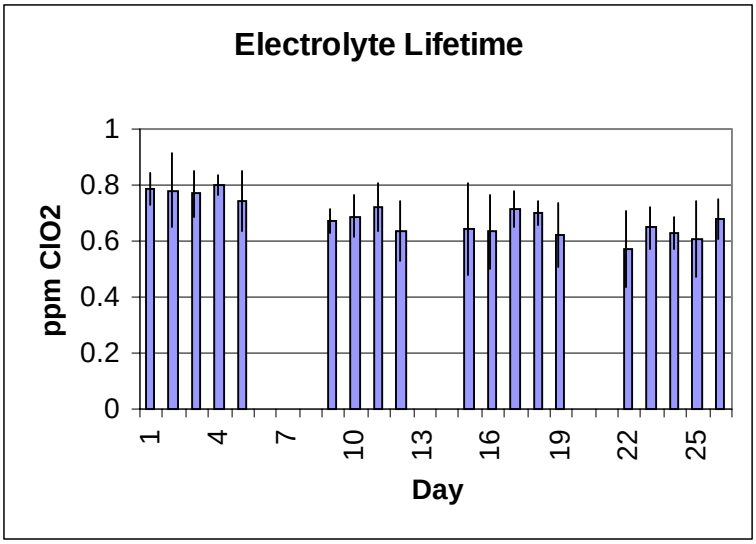

Although the generator was set to produce 1.00 ppm chlorine dioxide, the average measured concentrations consistently fell between 0.72 ppm and 0.80 ppm throughout the week. The coefficient of variation for chlorine dioxide output over the course of the week was 7.54%.

**Extended Run Time Evaluation:**

The next objective of the study was to assess the consistency of the generator when left running for an extended period of time. Four hours was chosen as the length of time for the test period in order to simulate, for example, an operator turning the generator on in the morning and leaving it running until lunch. Chlorine dioxide output was verified every 30 minutes throughout the test period using the NCASI method. The generator maintained a reasonably stable output over the four hour test period.



**Electrolyte Lifetime:**

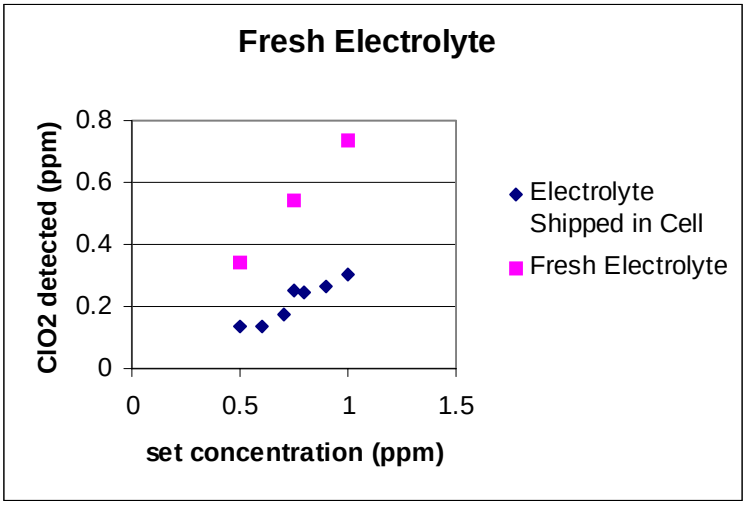



The purpose of this portion of the study was to evaluate whether the electrolyte retains its effectiveness until the one month recommended replacement time. After fresh electrolyte was mixed and placed in the cell, chlorine dioxide output was verified twice each day, as described in the accuracy evaluation. This process was continued over the course of almost one month until the cell failed. The concentrations of chlorine dioxide generated remained relatively stable throughout the test period, although the concentrations produced at the beginning of the month did tend to be higher than those produced later in the month, with the average output during the first week being 0.78 ppm and that during the last week being 0.63 ppm.

**Cell Lifetime:**

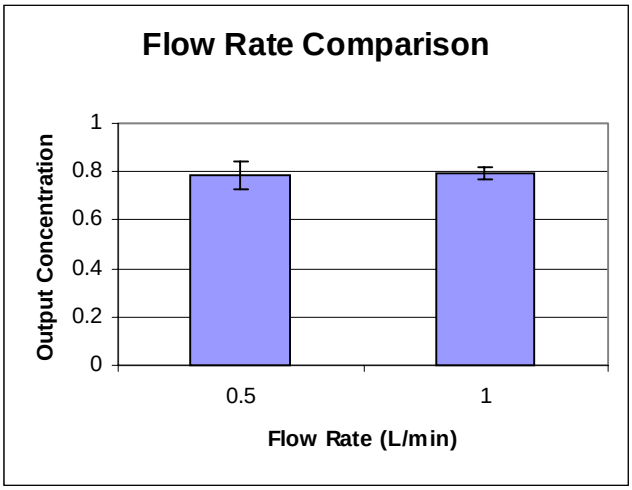
A fresh electrochemical cell was installed in the generator and a tally was kept of the time the generator was in operation. The generator ran for 50.5 hours before the cell failed. This time includes the ten minute warm up period each time the generator was turned on, but not the purge period after the generator was turned off. The lifetime recorded in the laboratory is very close to the 50 hour lifetime for the cell advertised by the manufacturer.

**Impact of Fresh Electrolyte :**




This portion of the study demonstrated the importance of replacing the electrolyte shipped in the cell before installation. First, the cell was installed as shipped. The generator was set to several different concentrations and readings were taken. Then, the electrolyte in the cell was replaced with freshly mixed electrolyte and the cell was reinstalled. Again, readings were taken at several different concentrations. The flow rate for this demonstration was set at 1.0 L/min. The concentrations produced by the generator were much closer to the set values after the original electrolyte was replaced. These results reiterate the finding of the manufacturer that freshly mixed electrolyte is essential.

**Flow Rate Comparison:**
The final objective of the study was to determine whether different flow rates had an effect on the accuracy of the generator. First, readings were taken at a flow rate of 0.5 L/min and a concentration of 1.00 ppm. Then, the flow rate was increased to 1.0 L/min and additional readings was taken. The concentrations detected at both flow rates are apparently not different. This suggests that flow rate does not affect accuracy.




**Conclusion:**
The CAL 2000 generator consistently produced 70-80% of its set concentration in these laboratory studies when fresh electrolyte was present. As the electrolyte aged, the concentration decreased to 60-70% of the set point at 2 to 4 weeks after the electrolyte was replaced. The chlorine dioxide generating cell with fresh electrolyte was reasonably precise, with a coefficient of variation of 7.54% over the course of the one-week evaluation of accuracy and precision.