

# The pHairway<sup>®</sup> Program

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## *Irrigation Water pH Control*

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*Combining chemical, equipment, turf expertise and service*

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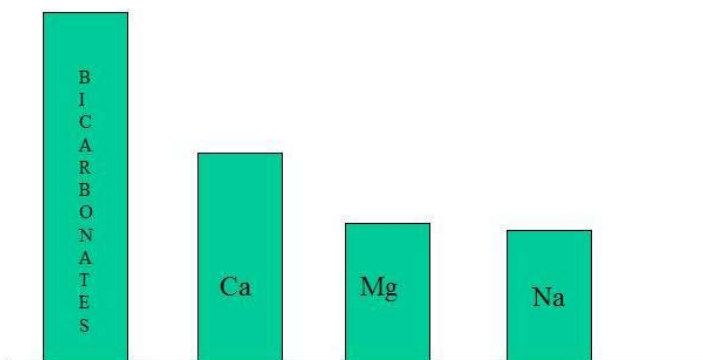
## Technical Overview

The detrimental effects of high pH and alkalinity in irrigation water on turf heath, vitality and appearance are well known:

- Poor plant response to fertilizers leading to increased use
- Increased water requirements
- Low Percolation rates
- Increased run off and standing water
- Localized Dry Spots
- Poor recovery in high stress areas
- Poorer drainage and runoff
- Increased herbicide usage
- Increased need for wetting agents
- Diminished greening
- Slower growth rates

The source of these problems are a result of a number of **chemical reactions** that occur in the water which then creates **physical changes** in the soil and ultimately effects the turf. These reactions are related to the water alkalinity, hardness and sodium.

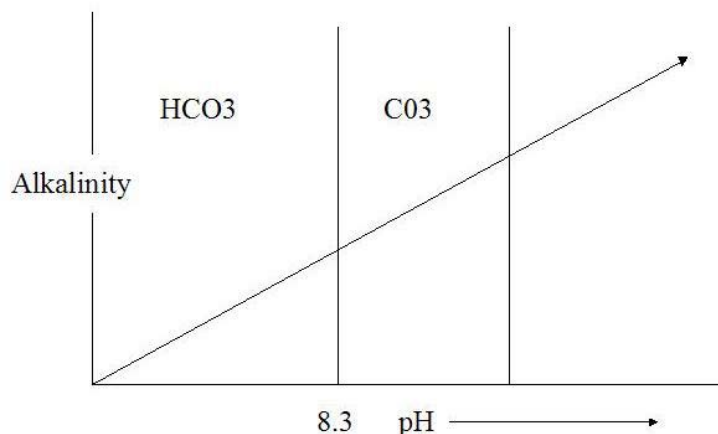
### Parameters of Concern



The typical volumetric relationships of these critical items are shown above. The alkalinity or bicarbonates ( $\text{HCO}_3$ ) can be considered the buffering capacity of the water and has a direct correlation with the pH of the water as shown below.

The values for calcium and magnesium make up the water hardness and are important for plant vigor via ion exchange at the soil particle exchange sites. Sodium has no value and is considered harmful for its ability to seal the soil and is even considered toxic at elevated levels.

## pH / Alkalinity Relationship

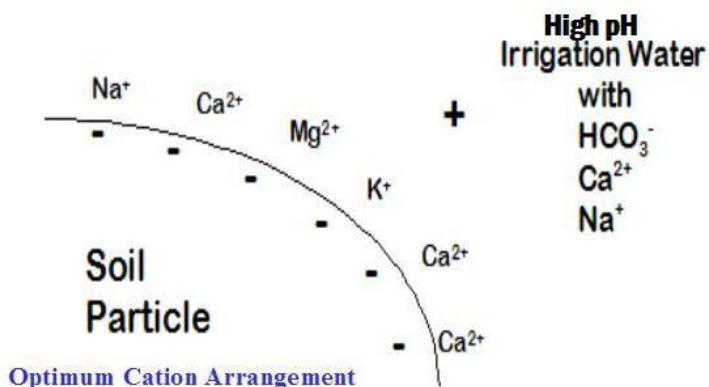


As the pH of given water increases, so does the alkalinity. The challenge of controlling the negative impact of this reality of nature is the controlled management of alkalinity. Since it is related closely to alkalinity, the industry measures pH (with a sensor) since the measurement of alkalinity requires a laboratory titration, which is not practical for control purposes. This is important because pH drives unfavorable reactions.

We have witnessed that water hardness (Calcium and Magnesium) found in irrigation water reacts with the available alkalinity to form soluble compounds and insoluble precipitates. For example: Calcium Bicarbonate is formed in the widely accepted reaction:  $\text{Ca}^{2+} + \text{HCO}_3^- < \text{Ca}^{2+} \text{HCO}_3 >$ . Typically in the Midwest, desired Calcium values are in the 40-120 range with a desired bicarbonate alkalinity of <120ppm as  $\text{CaCO}_3$ .

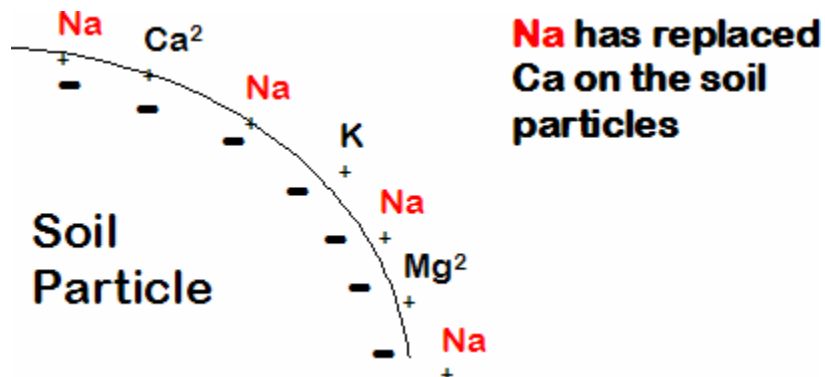
In instances where these values are exceeded, the benefits that Calcium and Magnesium provide are lost as a result of the water hardness being “tied up” by the bicarbonate alkalinity. In the case of calcium bicarbonate, two notable results are seen in poorer overall soil porosity and the accompanying decrease in micronutrient uptake. In addition, diminished magnesium has a detrimental effect on soil binding.

## Impact Of Untreated Irrigation Water



The figure above illustrates the optimal soil particle ionic balance before high pH /alkalinity irrigation water is added.

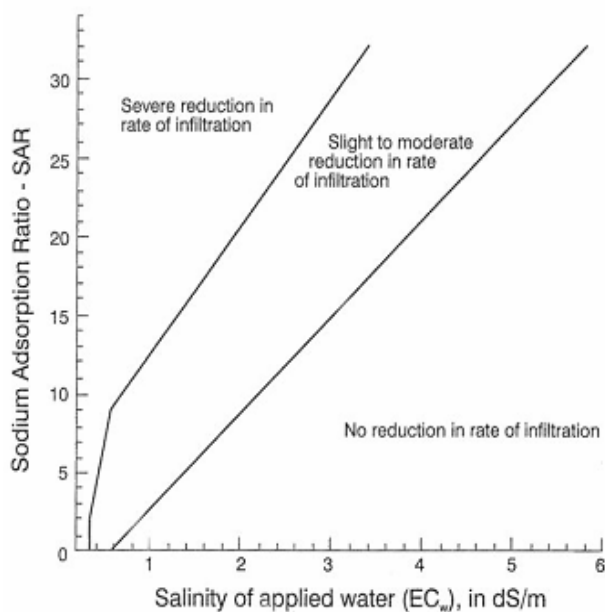
If the high pH/ alkaline water used for irrigation goes untreated, the reactions; shown in the previous illustration; lead to diminished levels of Calcium and Magnesium (because they are tied up by the bicarbonates). This absence of free Calcium and Magnesium in the water allows sodium to become the predominant cation. This leads to sodium build up in the soil, which diminishes soil particle aggregation. This build up occurs as sodium ions adsorb onto cation exchange sites in the soil. This displaces elements needed for plant growth. This is considered an *INDUCED* Sodium problem.



Sites that would normally be occupied by Calcium and Magnesium are now occupied by Sodium. (The soil seeks an ionic balance). This disrupts the soil structure and causes plugging. Internal drainage and percolation rates decrease, thus making the delivery of other program components such as fertilizer to plant roots less efficient. In addition, the availability of micronutrients such as iron, manganese, zinc, copper and boron can be reduced by high pH.

The negative effects on infiltration rates due to an increase in the Sodium Adsorption Ratio have been well documented in technical literature as measured by the relationship between Sodium, Calcium and Magnesium.

### The Effects of Sodium on Decreasing Water Infiltration

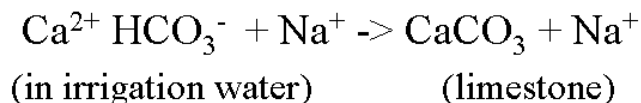


Relative rate of water infiltration as affected by salinity and sodium adsorption ratio.

The resultant soil profile sealing due to Sodium build up; as illustrated in previous example; is further aggravated by the build up calcium carbonate (limestone) which is a function of the evaporative effect and the cycling of alkalinity and calcium.

## Formation of Calcium Carbonate

Bicarbonate ( $\text{HCO}_3^-$ ) will precipitate Ca and leave Na in solution.



*Alkalinity moves toward Carbonate  $\text{CO}_3$  as evaporation increases pH via decomposition of  $\text{CO}_2$*

The calcium carbonate is an insoluble precipitate, which is crystalline in nature. It seals the soil further, decreases water penetration and forms a matrix, which binds fertilizer rendering it useless.

The induced sodium sealing and formation of Calcium Carbonate create a series of problems for the turf manager trying to apply a comprehensive management program.

## Make it Rain

As any superintendent can tell you, the answer to many of these problems is a good hard rainfall. This is due in large part to the acidic pH of rain (pH=5.5). Rain destroys the matrix, neutralizes the bicarbonates and releases calcium and magnesium, which in turn flush the soil sealing sodium as discussed above. Confirming the fact that plant response to rain is clearly better than to irrigation water.

However since we can't make it rain when and where we want, we often attempt to deal with impact of poor quality water in a number of ways. We water and fertilize, we water some more and spray, we water again and maybe add an amendment and water some more. All with the same poor quality water that gave us the problem in the first place!

This approach deals with the symptoms but does not "fix" the problem.

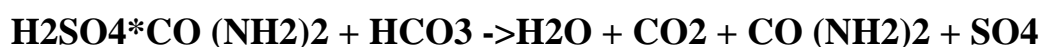
To address these issues, hundreds of golf course superintendents have learned that the application of a pH control amendment can have a highly positive effect in reversing the problems discussed above. The Value Added Program offered by Prime Turf is summarized on the following pages.



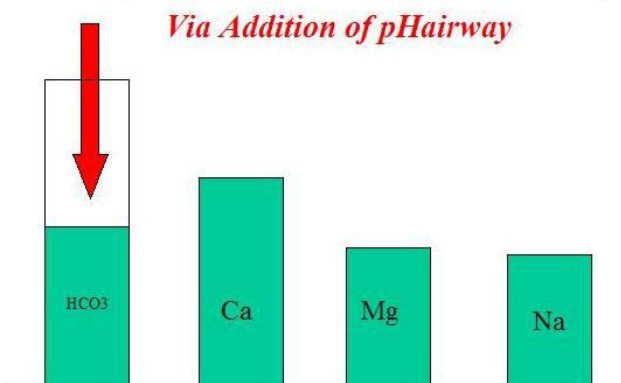
To prevent the occurrences noted previously, the use of an acid based material to lower pH and alkalinity has been proven to be effective.

The *pHairway*<sup>™</sup> **Total Program** has been proven in hundreds of applications. The relationship between pH and alkalinity gives the user a simple reading with which to gauge and control the effectiveness of such a program.

pH / Bicarbonates are controlled by the following reactions via the addition of pHairway<sup>™</sup>



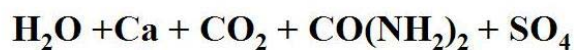
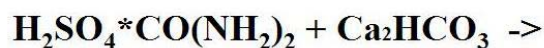
### Alkalinity Destruction



Irrigation waters controlled to the 6.0-6.5 pH value range, destroys enough alkalinity to bring it in within the desired range described above. This assures that the precipitation reaction mentioned above does not remove all of the soluble calcium from solution in the irrigation water and eventually the soil structure. This in turn makes the divalent calcium (Ca<sup>++</sup>) ion (soluble or free calcium) able to displace or exchange the weaker monovalent Sodium (Na<sup>+</sup>) ion within the soil structure, thus maintaining porosity and an open profile. This open profile then improves the efficacy of the balance of the turf management program. Accordingly, the benefits described earlier are achieved.

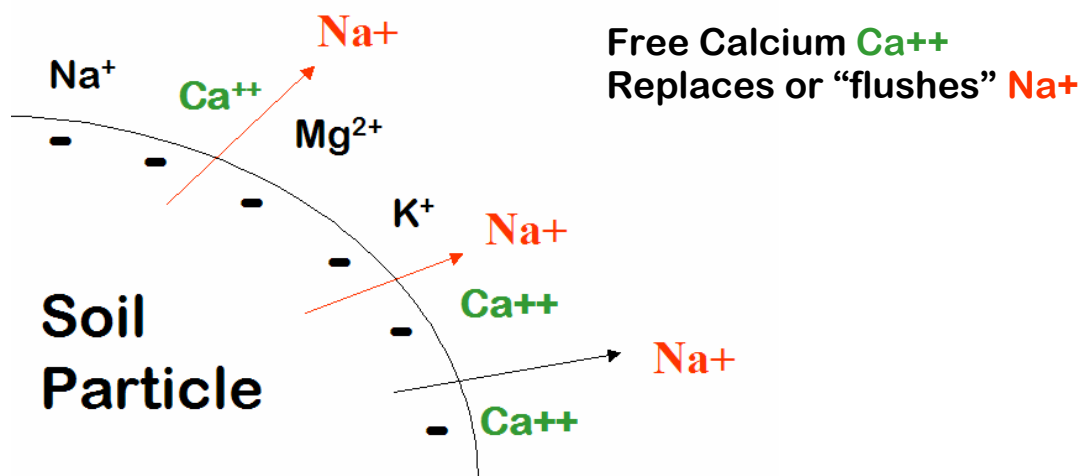
### Impact of Alkalinity Destruction

#### *Calcium Liberation*



Calcium Free For Ion Exchange

The impact of this Calcium liberation is a re-optimized soil environment as shown below:



In addition, the lower pH in the treated irrigation water dissolves the matrix of calcium carbonate and releases bound nutrients for plant uptake. The result is similar to the greening we see after a natural rain, which has a low pH.

The pHairway™ program slogan “Right as Rain” came from this phenomena.

The use of the pHairway™ product in hundreds of applications has shown significant improvements in overall turf health and vigor.

**Turf Improvements** reported by pHairway™ users include:

- Greatly improved response to fertilizer
- Increased infiltration and percolation rates
- The elimination of “Dry Spots”
- A pronounced “Greening”
- Improved draining /elimination of standing water
- Improved recovery in high stress areas
- Longer half life of herbicides

**Economic Improvements** attributed to the proper use of pHairway™ have been:

- Less water usage
- Less energy consumption
- Less fertilizer use
- Decreased use of expensive wetting agents
- Less hand watering
- Less herbicide use
- Longer equipment life
- Increased “playability”



### *“The Value Added Difference”*

Prime Turf has proven its commitment to our customers through the effective management of a comprehensive **Value Added Program** designed to provide results at an economical cost.

Top performance and maximum benefits come from the *COMBINATION* of Chemical, Application Expertise, Equipment and Service. The relationship of these elements is essential to providing our customers with the results they are investing in.



Each component of the *Total Value Program* can be compared to the legs of a table. Each leg supports the foundation upon which results and performance rest. Without one of these elements, the results cannot be achieved.

Prime Turf has built an integrated bundle of unmatched capabilities to offer our clients.

Patented manufacturing processes producing unique, high quality chemistries are combined with full on-site service and application expertise providing safe, reliable chemical delivery by certified experts in custom designed Prime Turf trucks. This service is extended to the installation and ongoing maintenance of proprietary control, feed and monitoring equipment specifically designed to implement the program in the most cost-effective means possible.

## The Chemical

The pHairway™ product is manufactured by professionals with a unique, patented process developed by the world-class experts at Agrium. This continuous flow process produces a level of quality that cannot be achieved by lesser batch process producers. The use of specialized initiators in the continuous process assures pHairway™ users an unmatched consistency in purity and activity. This is a unique product resulting from a carefully controlled manufacturing process that combines urea and sulfuric acid. The resulting product is contaminant-free, and contains additives to control metal corrosion. The unique nature of pHairway™ has enabled it to register several U.S. patents covering various use, compositions, and methods of manufacturing.

The users of pHairway™ product do not have to worry about inconsistent batches, contamination and the potential drop in effectiveness associated with decreased activity that is often seen in batch process product. Manufacturing in four major refinery class facilities across the country assure our customers they will get our product when they need it without delay or compromised quality.



### Specifications

#### *GUARANTEED ANALYSIS*

Total Nitrogen	
Water Soluble (Urea).....	15.00
Phosphate Sources.....	0
Potash Sources.....	0
Sulfur from Sulfuric Acid.....	16.00

#### *PHYSICAL PROPERTIES*

Crystallization Temperature...	42+3F
Viscosity at 68 F.....	49 centipoise
Specific Gravity at 68 F.....	1.52
Pound per Gallon at 68 F.....	12.70
Gallons per Ton.....	157.48

The high quality standards of these facilities guarantee that the product delivered to our customers will meet the exact specifications. This not only assures performance but critical safety considerations as well.

## *The Equipment*

The Prime Turf G2 is the newest generation and most advanced dual programmable chemical injection station. From conception to proven field performance, the G2 offers golf course superintendents a world of state of the art capabilities.

This second generation of leading edge technology combines proven time tested design and the new IntelliDose Controller system. With an emphasis on ease of operation and outstanding programming flexibility, the G2 gives turf professionals the ability to fully integrate chemical injection into any turf management program.

The G2 system incorporates corrosion resistant stainless steel Alloy 20 pump components and Prime Turf's own patented injection lance. True VFD technology drives the output of the controller unit. This combination of control and monitoring guarantees that each customer's investment is maximized and the benefits of all programs are fully realized.

Offering a perfect balance of performance and programming ease, the G2 is capable of operating multiple independent automatic schedules. Each schedule can have independent pH set points, start times and days per week selections. Additional features include, automatic probe cleaning function, alarm lockouts, and a remote activation feature which integrates the unit into existing irrigation control systems.



- **pH Control & Fertigation Applications**



### **New IntelliDose Controller Technology**

- **Improved Sensor Response**
- **Multiple pH Set Point Flexibility**
- **Remote Control Capability**
- **Proven Reliable Components**

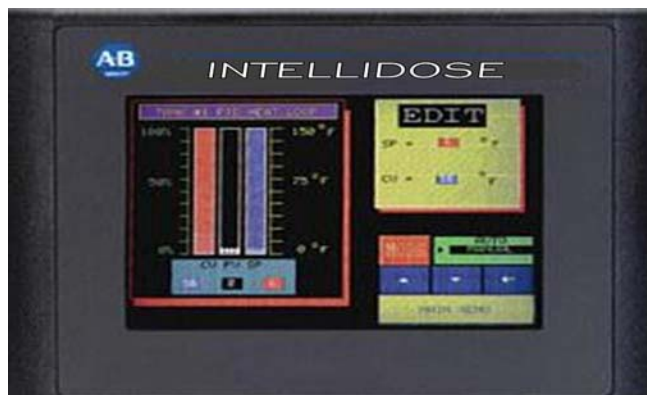
## **G2**

### **Irrigation Chemical Injection and Monitoring System**

**The G2 is driven by the industry leading IntelliDose controller, making it the most flexible and expandable system on the market.**

# INTELLIDOSE

## PROGRAMMABLE CHEMICAL MANAGEMENT CONTROLLER



This new, state-of-the-art controller combines advanced Demand Based Control and Customized Distance From Set-Point Logic. This new level of sophistication brings the tightest control possible to a wide variety of chemical feed programs.

The advanced microprocessor-based controller provides maximum flexibility and programming options. Up to eight separate liquid chemical programs can be fully integrated and operated independently.

Users can select unique pH set points for greens, tees, fairways and roughs and even select times and set points for weekly flushing events.

The IntelliDose unit can be activated remotely and fully controlled by an existing irrigation satellite connection. Daily adjustments due to watering cycle timings are eliminated with this integration feature.

The station's operator interface is a user friendly programmable logic controller with a flat panel full color, touch pad screen. All menus are displayed in easy to read digital format and sequential graphics.

This controller will optimize any program results. It gives turf professionals the flexibility to manage the programs based on specific needs in specific areas under specific conditions.

## The Service

A program is only as good as the service it provides the customer. Furthermore, the service is only as good as the people who are responsible for executing it on our customers' behalf. Our dedication to superior customer service has been proven time and time again. We are staffed with turf experts at every level of our business. Prime Turf has consistently *exceeded* our customer's expectations for critical elements of service such as:

- Safe, Efficient Delivery
- Equipment Installation and Service
- Continuing Care Programs
- Service Contracts
- Start Up And Winterization Programs
- Special On-Site Performance Monitoring Programs
- Rapid Response To Trouble Shooting Calls
- Water & Soil Testing

**Equipment Installation and Start up** – Prime Turf customers enjoy a full installation commitment covering all our chemical feed and monitoring systems. We install the systems complete along with any / all related equipment purchased from Prime Turf. During start up, our customers receive a comprehensive training on the equipment design and functionality along with a general program summary and full documentation. Our attention to detail assures a smooth program implementation and trouble free operation.

**Delivery** - Our unique chemistries are delivered in state-of-the art, custom-built tanker trucks. We provide our own certified delivery specialist. They are instructed on proper chemical handing techniques and safety considerations to ensure efficient and safe chemical transfer.



**Water / Soil Testing** – We provide, no obligation, complete water analysis. Third party, independent experts at Brookside laboratories develop a comprehensive assessment of the irrigation water which becomes the foundation of the database used to design and monitor the performance of our treatment programs.



**System Audits** – A complete review of your goals, existing conditions and the current state irrigation treatment is summarized in a series of formal recommendations / proposals designed to optimize your overall objectives related to turf quality. Year-end performance reviews are conducted after each season.

## Performance Optimization Program

To expand our service commitment, Prime Turf has established the **Performance Optimization Program (POP)**. POP begins with a free on-site visit. This is the first step in establishing a pHairway program specifically designed for each customer's needs and requirements.

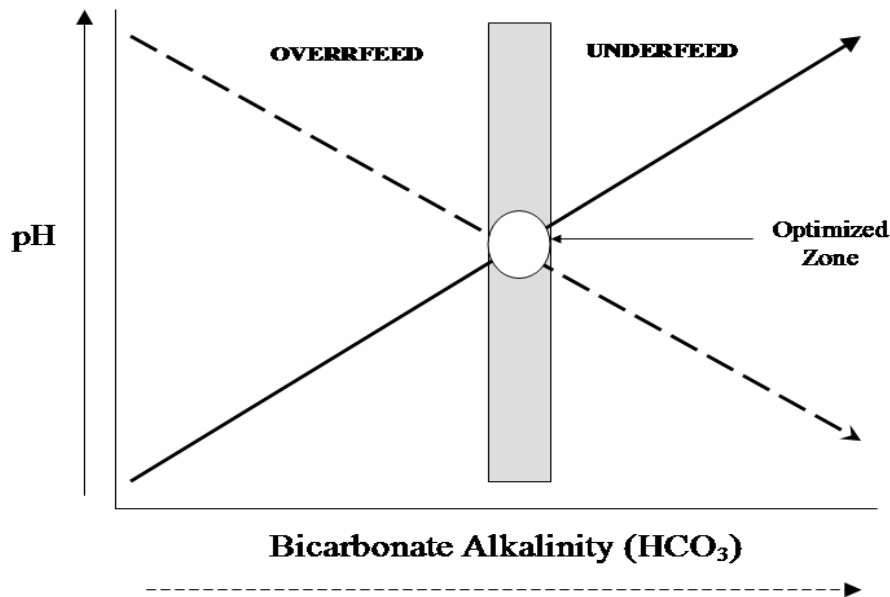
The **POP** process is simple! It guarantees that each customer's specific program is properly calibrated to provide accurate control for stable and consistent results.

- Samples are collected from treated and untreated water sources.
- On site tests determine pH and Bicarbonate (BiC) levels.
- The Bicarbonate Kill Rate (BKR) output is determined.
- An actual performance "report card" is generated, comparing current system levels to optimal recommended settings.

The goal of this process is to provide each customer with the specific information necessary to maximize the benefits of the program.

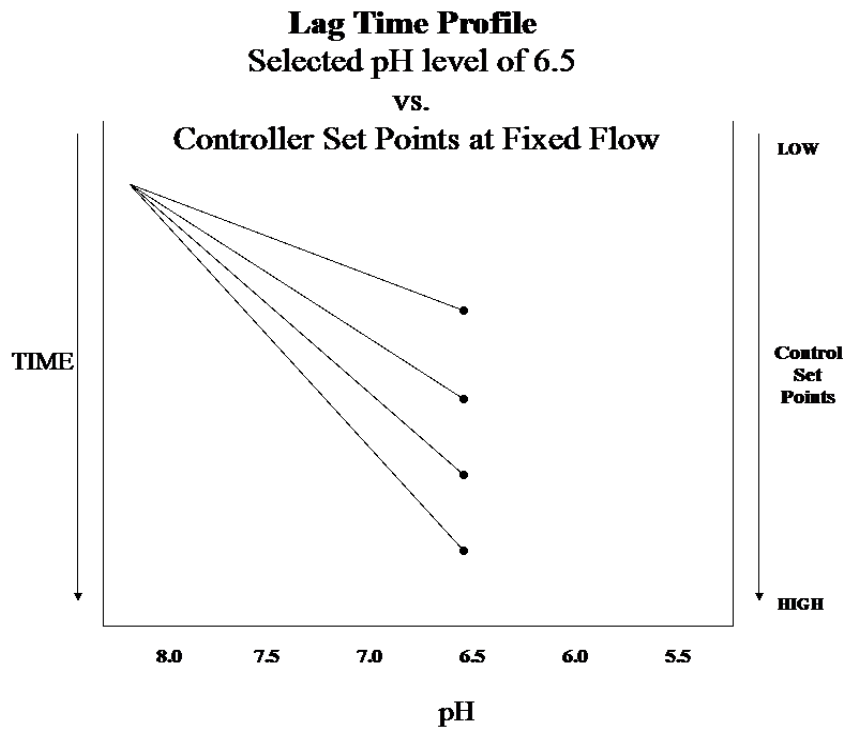
Identifying the **Optimal Bicarbonate Control Zone** for your specific conditions will enhance your ability to use the program to respond to changing requirements.

### ESTABLISHING OPTIMAL BICARBONATE CONTROL ZONE



The optimal zone of control is established by observing calcium levels in response to actual treatment performance under varying levels of stress. This is an on-going process of fine-tuning.

In addition, we begin establishing base-line data to determine the Lag-Time Profile at various points around the facility. This helps identify the set-point to performance relationship in real time values.



This exercise has been proven to be useful in determining usage rates which need to be modified in your program during periods of intermittent use.

Further more, we develop a program for continuing lag-time evaluation to ensure the prescribed feed rates correspond with existing irrigation practices, eliminating any over/under feeding.

In conclusion, we meet to review the data, submit our recommendations and determine future goals and considerations for your club.

The net result of this work is a greater working knowledge of the program, its' performance and how it can be fine-tuned for greater results.



## **Our Mission**

*We offer turf management professionals high quality, innovative products, services and application expertise related to all areas of turf water treatment.*

*Our Total Solution Programs combines specialized chemistries, feed / control equipment and dedicated on-site service to create value and solve problems for our customers.*

## **Our Core Values**

### **Customer Focus - Customers drive our business.**

We understand that we will grow our business in a profitable fashion by caring for our customers better than our competition can. We believe that building long lasting customer relationships will drive new and recurring business opportunities. We will not be distracted from a single-minded focus on creating value for our customers.

### **Quality - We offer unmatched quality.**

We seek excellence in every endeavor and will not compromise for any reason. We expect our employees and business partners to excel. This will allow us to exceed our customer's highest expectations.

### **Entrepreneurial Spirit - An engine for innovation.**

We bring new, significant problem solving ideas to our customers in a consistent fashion. Our open-minded approach to business allows us to actively seek fresh, creative ways to help our customers meet their operating objectives.

### **Ethics - We conduct our business with integrity.**

Our behavior is driven by a deep respect for people along with an uncompromising commitment to a high moral code.

### **Teamwork - We function as a team.**

We support each other and work together to create a business that reflects the talents and diversity of all employees.

### **Continuous Improvement - We are never satisfied.**

We strive for improvement in all aspects of our business. We actively seek the expression of opinions from customers and industry colleagues to help guide our direction. We routinely raise the bar of self-expectation and set new benchmarks of performance