WATER TEST RESULT AND REPORT

Site: South Shields Golf Club

Date: 25th September 2020

TERRALIFT
PERFORMANCE FERTILISERS

www.terralift.eu /terralift @terralift

WATER ANALYSIS REPORT

TERRALIFT
PERFORMANCE FERTILISERS

Prepared by: Kima Omara (B.Ag.Eng, MSc) Date: 25/09/2020

A report and analysis on the suitability of a water supply for irrigation purposes

The attached analyses and calculations show a water with a positive Langelier, which means that it will *block* the soil structure leading to permeability and infiltration problems. The analysis showed a water that is very '*hard'* i.e. high in calcium level, and also very high in bicarbonate content. Consequently, this water will cause formation of small particles of lime-scale in the soil, like the scale formation seen in a shower head or boiler and with the same results, blocking the soil pores causing poor infiltration rates and bad permeability. As the soil pores block, surface run-off from high points is caused and the soil 'caps'. The water has a low iron content and other essential trace metals such as boron and manganese are not present in good quantities. The pH of this water is higher than recommended for growing fine turf grasses and high pH irrigation water will limit optimum turf growth and upright stance If used without correct treatment this water has a high potential for causing soil permeability problems and poor infiltration rates, this will lead to water being trapped in the upper soil layers of the green and causing *'sponginess'.* Thatch will build up as suspended solids cannot move through the soil profile as it becomes blocked – this will consequently trap fertiliser additions in top layers leading to high levels in certain areas and diseases such as anthracnose may become a problem. Other obvious signs of the problems this water will cause are:

1. Dry patch.

2. Surface slime formation (anaerobic bacteria on the soil surface).

3. Grass under stress despite frequent irrigations.

The water currently has an unacceptable level of bicarbonate (300ppm) coupled with a pH that is high with the levels of calcium. The report shows that the **addition of 215ml Quadrop Balance FS to every 1000Litres** (220gallons) of water will change the water from being unsuitable to actually being 'fit for purpose'. The analyses and calculations show how the addition of Quadrop FS changes the out of specification parameters to being within the recommended limits. Soil permeability rates will be vastly improved and the problems listed above will be minimised. Also shown is the 'boost' to the nitrogen level that dosing 215ml of Quadrop FS will give to the plant every irrigation cycle. The soil profile will be maintained '*open'* which will assist in minimising thatch build up and all the other problems associated with a blocked upper soil layer spells, in addition to supporting minerals like sulphur, to remain available to the plants, while clearing excess from the profile. The pH is reduced to an ideal 6.5 and out of specification parameters are within/closer to the recommended levels.

As the greens are effectively de-scaled, and the permeability improves along with the health of the turf, the Quadrop dosage could be reduced to 200ml per 1000litres. The pH of the water will rise slightly to 6.8 to 7 but the scaling potential (Langelier index) will still be –ve, so permeability will be maintained. This course of action should be

discussed with your Quadrop representative and plant growth and wilt rates should be carefully monitored.

Adding Quadrop effectively *softens* the water, reducing the surface tension and leading to faster movement of the water through the soil profile, this may reduce the need for wetting agents when the treated irrigation water is used. Also as a residual amount of Quadrop builds in the soil the movement of rainwater is also speeded up leading to better draining and disease suppression. Due to the now acidic water good colour hold will be maintained even in dry/drought conditions as the water can move easily through the profile and the nitrogen and other essential minerals are easily transported to the root zone.

WATER TEST RESULT

TERRALIFT
PERFORMANCE FERTILISERS

Site: South Shields Golf Club

Water source: Borehole Soil type: Not stated

Sample taken by: Philip Newton Sample date: 21/09/2020 Date analysed: 25/09/2020

Test parameter		Ideal ***	Actual	After *Quadrop*
pH		5.5 to 6.8	7.5	6.5
Calcium	(ppm $CaCO_3$)	>10	251	251
Magnesium	(ppm $CaCO_3$)	>40	95	95
Sodium	(ppm Na)	< 70 *	43	43
Total Alkalinity	(ppm $CaCO_3$)	<120	300	120
Bicarbonate	(ppm $CaCO_3$)	<90	300	90
Carbonate	(ppm $CaCO_3$)	Nil	0	0
Hydroxide	(ppm $CaCO_3$)	Nil	0	0
Conductivity	μScm^{-1}	280 – 2000	1100	1100
Total Dissolved Solids	ppm	180 – 1280	770	770
Sodium Absorption Ratio SAR		0 – 4	1.01	1.01
Adjusted SAR or SAR_{adj} **		0 – 3.5	1.3	1.3
Langelier Saturation Index LSI		-2 to 0	+0.97	-0.03
Chloride	ppm Cl-		28.5	28.5
Iron	ppm Fe		0.03	0.03
Potassium	ppm K		0.9	0.9
Phosphate	ppm PO_4		0.84	0.84
Sulphate	ppm SO_4	25 - 200	99.5	233
Manganese	ppm Mn		0.01	0.01
Complex Nitrogen	ppm N		0.1	+46 (Boost)
Boron	ppm B	<2	0.02	0.02
Suspended solids	mg/l	<1.25	1	1

* Only causes foliar damage, salt burn that is removed by mowing therefore not normally a problem. For root problems refer to the Sodium Absorption ratio SARadj.

** This is calculated and varies according to the salinity of the water (see attached notes).

*** Ideal values may not be correct if the soil has permeability problems and/or where it is low on essential minerals and the water is leaching minerals out of the soil.

FURTHER INFORMATION

TERRALIFT
PERFORMANCE FERTILISERS

The suitability of irrigation water for turf grass is a complex subject and depends on many criteria. The most important factors in order of importance are: -

1. Type of soil and soil structure.
2. The Bicarbonate content of the water that directly affects the solubility of Calcium and Magnesium in the soil. The Langelier Saturation Index (LSI) has been used to show this relationship.
3. The ratio of sodium to calcium and magnesium ions, commonly known as the SAR (Sodium Adsorption Ratio).
4. The presence of any specific ion toxicity e.g. Boron.

Soil structure is important because water with high sodium content may be detrimental to a fine-textured (clay) soil causing deflocculation and breakdown of the clay particles. This reduces soil aeration, water infiltration and percolation. However in coarse textured (sandy) soils permeability problems are less severe so higher sodium content can be tolerated. The permeability of a soil also affects the plants susceptibility to the SAR and potentially phytotoxic ions.

The bicarbonate content is critical as to whether a soil maintains its permeability or becomes choked. The bicarbonate content also determines the level of soluble calcium and magnesium in the soil and hence directly influences the SAR. High levels of bicarbonate increase the SAR causing reduction in soil permeability leading to poor plant growth (dry patch) and disease.

The Langelier Saturation Index (LSI) calculates for a given water analysis the potential for that water to *block* the soil structure leading to conditions like 'dry patch', surface capping and thatch build up with associated disease problems or whether the water has a high leaching potential leading to loss of vital minerals and nutrients from the soil. The higher +ve number of a LSI the greater the potential for the water to block the soil and the higher –ve numbers shows an increasing potential for leaching. A low negative value for LSI indicates good soluble calcium and magnesium ions and is preferred. An ideal range for LSI is –2 to 0. LSI is calculated from the following formula: -

pHs = (9.3 + a + b) – (c + d)

Where: a = (log(TDS*2) – 1) * 0.1
b = -13.12 * log (Temperature{25C}) + 34.55
c = log(Calcium*2) – 0.4
d = log(Alkalinity*2)
LSI = pH(actual) – pHs (calculated above)

The LSI is recalculated in the analysis to show how the required addition of *Quadrop* makes the water 'fit for purpose'.

The sodium adsorption ratio, SAR, became widely used after 1954 to give an indication of irrigation water potential to cause infiltration (permeability) problems. The simple formula for SAR is;

$$SAR = \frac{Na}{\sqrt{(0.5(Ca + Mg))}}.$$

Where Ca, Mg and Na are all expressed as $meqL^{-1}$. Sometimes SAR is reported as RNa but the terms are synonymous. It has been found recently that the SAR formula does not account for the change in calcium and magnesium levels that occurs when the irrigation water reacts within the soil. Consequently 'Ayers and Westcot' paper 'Water quality for agriculture' produced for the Food Agriculture Organisation of the United Nations 1989 recommends using an adjusted SAR to take into account the change in calcium in the soil water. This adjusted SAR is simply known as $SAR_{adj.}$

$$SAR_{adj.} = \frac{Na}{\sqrt{(0.5(Ca_x + Mg))}}.$$

Ca_x is calculated using tables that take into account the effects of Carbon Dioxide (CO_2), of Bicarbonate (HCO_3) and of salinity (EC_w) in the actual soil as opposed to taking the irrigation water in isolation. It is quite possible for a water to appear suitable for irrigation on the simple SAR calculation but the adjusted SAR may show a potential problem. Our analyses detail both the SAR calculations but the emphasis is on the adjusted $SAR_{adj.}$ Our report also details the maximum adjusted SAR_{adj} that can be tolerated for the salinity of particular water this is calculated by using the formula;

Maximum $SAR_{adj.} = (6.4\ EC_w) - 2.8$ (*Ayers and Westcot FAO U.N. 1989)*

Where EC_w = Electrical conductivity of the water mmhos/cm.

A –ve value for this figure or zero indicate a water with a high leaching potential and this too can cause permeability problems as vital minerals are leached from the soil leading to soil structure breakdown and poor infiltration rates.

We also calculate the improvements that come from dosing *Quadrop* to the water. We show the improvement to pH, the adjusted $SAR_{adj,}$ the Langelier Saturation Index and the bicarbonate levels, sometimes even the suspended solids will improve. This demonstrates how a small addition of the required *Quadrop* product can make the water 'fit for purpose'.

The mineral transporters in *Quadrop* also make the now unlocked supplementary nutrients in the irrigation water - like N, K, Mn and Fe, ideal foliar additions to optimise upright leaf stance for faster, truer play at higher mowing heights. *Quadrop* itself contains added nutrients that become 'unlocked' after the bicarbonate level has been reduced, for interest the boost in these trace nutrient levels is also detailed – signified by a + level sign.

Finally we analyse for toxic ions and compare these with the maximum guideline levels set by the USGA for turf grass. However water with high bicarbonate levels, incorrect SAR ratios and/or poor permeability cannot tolerate even low levels of toxic ions as they concentrate in the soil and build up to toxic levels causing plant death.