ENGAGE
The Power of Nutrition

Aqualatus® Water Reduction Study

Landscape Trial | **AMWAJ, Egypt**

Crop | **Landscape Parkland**

Region of trial | **AMWAJ Holiday Destination**

Date of trial | **August - November**

Co-operators | **Elite WorldTrading (EWT), Sabbour Consulting and Hill International**

The following document covers the trial by EWT in Egypt with Sabbour Consulting and Hill International to assess the potential benefits of Aqualatus water saving technology from Engage in reducing water requirement on the AMWAJ Holiday destination.

AMWAJ Landscape ~ Aqualatus Trial

Aim of Trial

The aim of the trial was to implement the use of Engage's world leading water saving technology, Aqualatus, via irrigated water to landscape within two areas, one established parkland and the other a newly turfed area.

Both areas are within the newly developed AMWAJ Holiday destination set on Egypt's North Coast.

The use of Aqualatus in this trial was to dramatically reduce the water requirement to grow healthy, vibrant plants.

Aqualatus soil surfactant is regarded as the world's leading water saving technology in that it dramatically reduces water loss to the environment in three ways.

1. **Surface run off** – in landscaped areas soil can become capped or compacted which means water does not readily penetrate the soil surface. In this scenario, water runs away across the surface of soil into drainage channels or waterways leading to loss to planted areas and pollution potential.
2. **Evaporation** – in the heat of Egypt's climate the potential for evaporation from above ground irrigation is high especially from the surface of soils heated by the sun's radiation. Figures of 30-40% evaporation have been recorded.
3. **Gravity** – The soils in Egypt are almost pure sand which, due to soil particle size and lack of organic matter, is very free draining. This leads to high levels of gravitational water movement down through rootzones into subsoils and groundwater.

The unique technologies within Aqualatus have been proven to remove or significantly reduce the water loss issues and as Sabbour we using desalinated water from the Mediterranean sea which is expensive to do, they were very excited to see if Aqualatus could reduce water usage and aid establishment and maintenance of the landscaped areas.

Trials were conducted by the team of EWT and the teams of Sabbour Consulting and Hill international to validate the technology over a 4 month period and this has proven successful. The trial is discussed in detail within this document with results provided.

Aqualatus Technology

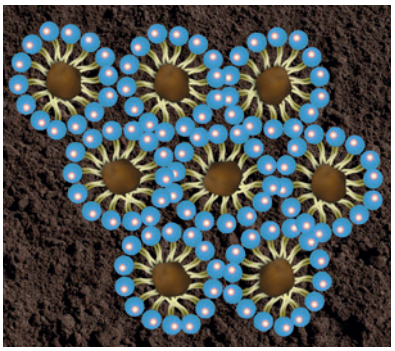
Aqualatus is a blend of four liquid technologies working together to save water. The unique formulation of Aqualatus eradicates surface run-off, dramatically reduces surface evaporation and slows the vertical movement of applied water allowing greater lateral movement which optimises root available water.

Benefits of using Aqualatus:

1. Maximum uptake of water and irrigation efficiency.
2. Optimal penetration and unique lateral movement of nutrients and other soil chemistries.
3. Maximum initial wetting and long term re-wetting of all soils and substrates.
4. Surface evaporation and run-off from soil is virtually eradicated.
5. A proven 65% reduction in plant water requirement with no loss of yield or quality
6. Up to 65% reduction energy and nutrient applications.

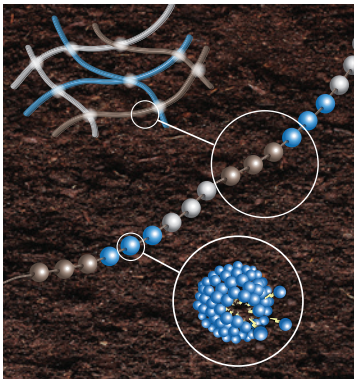
Aqualatus has been fully tested and proven in over 300 trials across the world over the past 12 years and is now the leading water saving technology across the world for saving water to support growing plants.

The Technology



Aqualatus is a blend of four liquid technologies working together to save water. Three are micellular technologies which are attracted to soil particles and to each other.

The micelles have a wavy tail which adhere themselves to a soil particle. The heads of the micelles are absorbent and acts like sponges to hold water molecules. The retention power of water by the micelles is strong so keeps far more water in the root zone of soils (top 5-90cm) promoting lateral movement of water, yet allowing availability to plants from capillary pull by their roots.



This important point is unique to Aqualatus, as traditional technologies used in soil water retention (hydrogels , humectants etc) absorb water at high levels, however, they do not provide adequate supply to plants.

Once Aqualatus is applied, the micelles join together construct a lattice web throughout the soil profile. The efficacy of the technology is increased directly by the number of micelles added, which allows for frequency of application to be adjusted.

As the lattice web builds throughout the soil profile so does the level of water retention. The soil never becomes water logged as the water retentive micelle's hydrophobic tail creates an air gap at every particle of soil, balancing the water to air ratio.

Environmental Credentials

With anything added to soils in the 21st century, environmental safety is key, especially if it is miscible or dissolved in water. Applied water to landscaped areas ultimately becomes ground water which could be used again in the future as drinking water or used for the needs of the population or in agriculture to enter the food chain. It is therefore important that Aqualatus is environmentally safe.

Aqualatus is predominatly made from carbon based micellular technologies with a fourth technology, an organic glucose surfactant added to deliver the micelles into the soil.

The total formulation fully biodegradable. 80% is broken down into root available CO^2 and the remaining 20% becomes food for soil microflora over the 8-12 week period. This allows is classification as fully biodegradable and is certified non bioaccumulative and not persisitent or harmful to humans, animals or the environment.

Concept for Sabbour and Hill International

The north of coast of Egypt is seeing dramatic growth in popularity as a high quality destination for tourists from the MENA region. Huge developments of villas, hotels, holiday parks and commercial infrastructure mean this will continue to grow over the coming years.

An important part of all developments is the use of large scale landscaping with plants from the region and beyond and these are irrigated to optimal level to create beautiful vistas to attract tourists and provide a welcoming landscape they will wish to return to year after year.

Once established, the landscaped area needs regular maintenance which importantly involves daily watering and nutrient support. As the region has little natural water this is provided primarily by smaller scale desalination plants and water recycling treatment systems.

The impact of the climate and sheer scale of the planting stimulates a requirement for huge amounts of water per day, with watering reaching as much as 12.0 litres per square meter daily.

EWT's Environmental division have been developing with Engage, the use Aqualatus technology for the reduction of water requirement for landscaped areas within the municipality of Dubai. The success of these trials has led to other ventures across the MENA region where successful trials in Jordan, Egypt agriculture, Algeria and Morocco have resulted in registration and commercialisation.

For the product to be accepted by Sabbour and Hill International trials work would need to be undertaken to assess the differences in use for the technology compared to standard practice. This was organised in August to run until November. The idea of this was to apply higher levels of Aqualatus to the north coast's sandy soils and gradually reduce the required water application level. Of most importance to this trial would be how much water could be saved as all water on site is from the sea and run through a reverse osmosis system to remove all salt before use which utilises a great deal or energy and creates a great deal of salt waste. There is also a waste water recycling unit which would be ideal for use however the volume produced is currently insufficient for the project.

Validation Trials Set Up

Two trials were organised on the AMWAJ Holiday destination by EWT, Sabbour Consulting and Hill International. The trials would look at the use of Aqualatus in both established landscaping and a newly turfed area within the AMWAJ development.

The trials were over seen by Dr Eng. Amro Kandil and his team who would both undertake management of the trials, application of Aqualatus and the taking of developmental images and moisture readings.

Aqualatus samples and soil moisture probes were supplied by Engage and Rula Al Atiyat from EWT would aid management of the trials. The sites would be visited regularly to liaise with Dr Eng. Kandil and his team on the progress made with the use of the technology and provide best practice advice for application and monitoring the site.

Trial Sites

Zone 1 – Established parkland

The area of Zone 1 was measured at 2350 m^2. The water rate used per day was 10 litres per m^2 therefore the rate of water used per day in the area was approximately 23,350 litres.

Equipment and Method

For the purposes of the trial mobile water tanks would be used to irrigate the area so not to compromise irrigation in other areas.

The irrigation was controlled by a direct pump system and a control timer to allow water flow to be controlled correctly. This was managed manually by the grounds staff on a daily basis.

Protocol for the trial

The following protocol was initially used for the trial.			
1	Take the daily normal water rate and multiply by 0.06 *e.g. water rate is 23,350 litres: 23,350 x 0.06mls = 1.40 litres of Aqualatus is required per month.*	9	Run at 30% less water daily for the 2nd week.
2	Fill mobile stock tank half full.	10	From the beginning of Week 3 reduce the watering by another 10% so overall reduction is 40%
3	Add desired amount of Aqualatus to the stock tank.	11	Run at 40% less water daily for the 3rd week.
4	Fill stock tank to maximum and stir.	12	From the beginning of week 4 reduce the watering by another 10% so overall reduction is 50%
5	Apply over the 2 watering's for the day until all Aqualatus is used. Therefore use half in the morning and the other half in the evening.	13	Run at 50% less water daily for the 4th week.
6	From the next day reduce the watering timing by 15% and water as normal	14	At the beginning of Week 5 repeat the application as per Week 1
7	Run at 15% less water daily for the 1st week.	15	Run at 50% less water daily for the next month.
8	From the beginning of Week 2 reduce the watering by another 15% so overall reduction is 30%		

Within this period observational photos would be taken, looking for both issues and benefits within the area trialled. The reduction of water and use of Aqualatus was designed to both reduce issues within irrigated area and highlight acute stress areas where water is applied far less than the desired optimal level.

It was recommended that 20 readings of each area would be taken weekly to at a depth of 5-10cms.

Zone 2 – Newly turfed area

The area of Zone 2 was measured at 233 m^2. As this challenging area had never been since its creation some months before, the water for day 1 was set at 10 litres per m^2, therefore the rate of water used per day in this area was 2,330 litres. Again for the purposes of the trial a mobile water tank would be used to irrigate the this would then be turfed for the purpose of the trial.

As with the larger area, watering was conducted manually by on-site grounds staff and used a controller and small pump to power the newly installed pop up sprinklers as seen below.

Protocol for Zone 2

The following protocol was initially used for the trial.	
1	Take the suggested water rate and multiply by 0.06 *e.g. water rate is 2330 litres: 2330 x 0.06mls = 140 mls of Aqualatus is required per month*
2	Fill mobile stock tank half full.
3	Add desired amount of Aqualatus to the stock tank.
4	Fill stock tank to maximum and stir.
5	Apply over the two watering's for the day until all Aqualatus is used. Therefore use half in the morning and the other half in the evening.
6	From the next day reduce the watering timing by 15% and water as normal
7	Run at 15% less water daily for the 1st week.
8	From the beginning of Week 2 reduce the watering by another 15% so overall reduction is 30%
9	Run at 30% less water daily for the 2nd week.
10	From the beginning of Week 3 reduce the watering by another 10% so overall reduction is 40%
11	Run at 40% less water daily for the 3rd week.
12	From the beginning of Week 4 reduce the watering by another 10% so overall reduction is 50%
13	Run at 50% less water daily for the 4th week.
14	At the beginning of Week 5 repeat the application as per Week 1
15	Run at 50% less water daily for the next month.

As Zone 2 would be challenging, it would be important to document the trial with weekly photos, looking for both issues and benefits within the area trialled. The reduction of water and use of Aqualatus would hopefully reduce issues within irrigated area and highlight acute stress areas as water would be applied far less than the desired optimal level.

Data would be essential for this site to document moisture levels as so using a soil moisture meter (see lower right) it was recommended to take 10-15 moisture readings across the turfed area at a depth of 5-10cms, to assess moisture retention in the rootzone.

The Aqualatus team from Dubai and England were set to visit at the beginning of Week 5 to assess the trials and application of Aqualatus for the second period.

Trials challenges and observations

During the trials period the areas faces several challenges. On the 2 August in Zone 2 the pump broke down so there was a gap in application for a day. This was corrected quickly by the AMWAJ team and the application was added day later.

The move to 15% reduction was taken after the first application and after the first week moisture readings were taken. Unfortunately no readings were taken before application of Aqualatus so it was not possible to see how the application initially influenced the water rate at the reduction of 15% however moisture levels in both areas were at an average of 55% after the first week.

After the first week the engineer testing the moisture levels broke the soil moisture probe supplied by ECS/EWT and so there was a gap in readings whilst a replacement was sent.

On the 14 August the pump broke down in Zone 2 again leading to a gap in irrigation of one day. Thankfully Dr Eng. Kandil organised to run the original irrigation system in the area to compensate for the pump until it was repaired.

The level of irrigation was reduced down to 30% and the second probe arrived.

Soil moisture meter

On the 17 August, photos from ENG. Moamen Hassanin showed some dry areas within Zone 2 leading the Aqualatus team to discuss whether the coverage from the irrigation sprinklers was adequate as the team noted unexpected dry patches.

Rula Al Atiyat visited the site and discussed the irrigation sprinkler placement and performance with Dr Eng. Kandil and the team set about rectifying the issues. Irrigation reduction was held at -30% during this period to allow moisture levels to increase and to allow time for the dryer areas to recover.

By Week 9 of the trial the areas were both looking very good and the problem areas in Zone 2 were recovering very well. The irrigation at this time had been reduced to -35%.

Photos taken from the 10 October

During late October a storm meant Zone 1 was flooded with salt water from the sea for a several days. It was thought that Zone 1 may need to be removed from the trial however, thankfully, the area recovered well and by November was looking very good again.

Moisture levels continued to rise as the trials progressed and the irrigation dropped on a weekly basis down to -50%.

Also in late October, it was decided a control area might be useful to measure moisture levels in the soils under normal irrigation application without the application of Aqualatus. This was implemented and moisture readings taken from early November and added to the overall results for comparison.

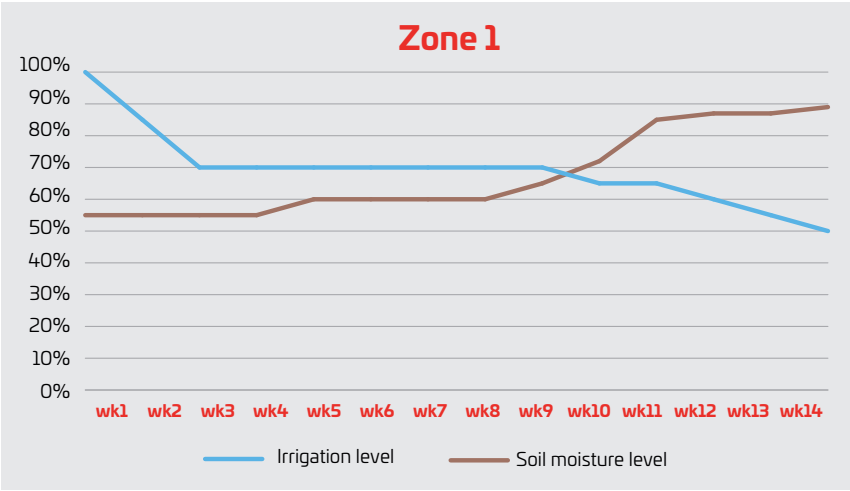
Results

Zone 1 – Established landscaping

2 August at 100% irrigation application

17 November at -50% irrigation application

The initial application protocol was to drop in weekly increments over a four week period. This was adhered to for the first four weeks however from moisture levels in the soil and on site photos is became apparent the due to the nature of the soils being mainly sand, slightly longer would be required to build the lattice web of micelles.



From Week 4 of the trial, moisture levels were maintained at -30% normal applications until soil moisture levels built up sufficiently to allow irrigation to be reduced further. By Week 11 the level had been reduced to -35% and then over a four week period to Week 14 irrigation was gradually reduced in increments of 5% to -50% normal application.

Moisture readings were taken over the period and the graph below shows how they improve with Aqualatus as the level of irrigation is reduced.

The graph (left) clearly shows that once the micellular web builds in the soil profile, moisture levels increase even as irrigation levels are reduced. By Week 14 moisture levels are consistently between 80- 90% even though irrigation is at 50% of normal application.

Results

Zone 2 – Newly turfed area

2 August at 100% irrigation application

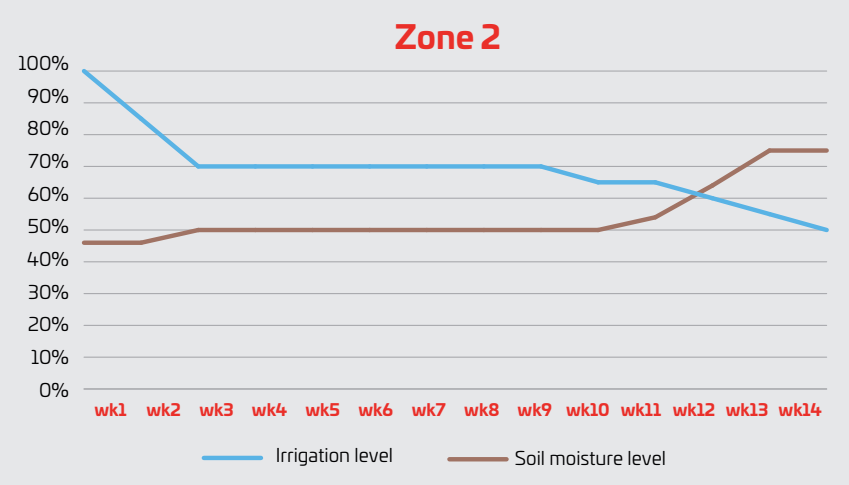
17 November at -50% irrigation application

Again the initial application protocol was to drop in weekly increments over a four week period. This was adhered to, however from moisture readings and on site photos, it became apparent the due to fact the area was pure sand which had received no irrigation ever before planting, longer would be required to build up the lattice web of micelles. From Week 4 of the trial moisture levels were maintained at -30% normal applications until moisture levels built up sufficiently to allow irrigation to be reduced. By Week 11 this had been reduced to -35% and then over a four week period to Week 14 irrigation was gradually reduced in increments of 5% to -50% normal application.

Moisture readings were taken over the period and the graph below shows how they improve with Aqualatus as the level of irrigation is reduced.

From the graph (left) it can be seen that there was a period of adjustment where the level of irrigation was held to allow moisture levels to increase.

Once levels of Aqualatus treated reached optimal the level of moisture rapid increases even when irrigation was reduced.



Control (Surrounding) Area

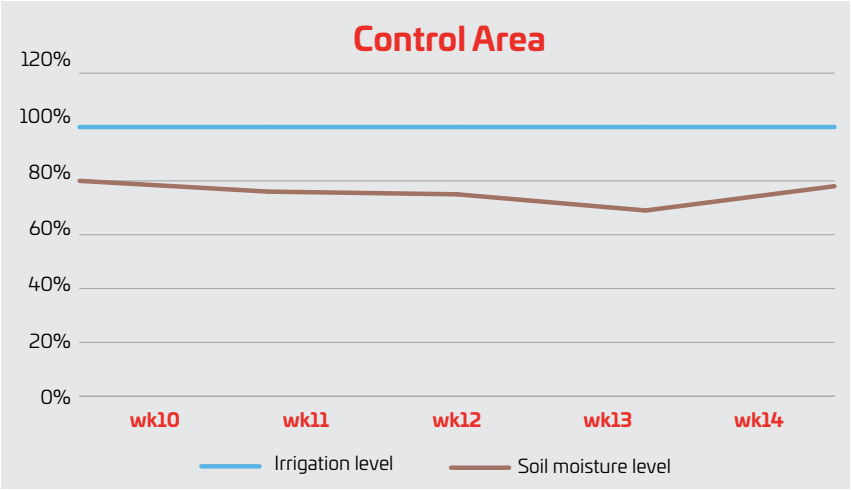
During the trials, a discussion was held as to whether it would be of value to see how the levels of moisture were performing in the surrounding areas under normal water application where no Aqualatus was being used. It was decided this would be of value so in late September the Egypt team began taking readings alongside those from the Aqualatus area.

It was an interesting parameter to add as it highlighted that even at 100% irrigation; moisture levels across the surrounding areas were uneven and were not as high as the established treated area.

The following photos and graph illustrates an average of the readings taken against irrigation level.

Within the surrounding area the teams could see how easily problems could arise from poor sprinkler coverage and blockage so practical advice was given on how to maintain the irrigation at optimum.

Control Area Graph



As can be seen in graph (left) the control area moisture levels are between 70-80% which when compared to the similarly planted established treated area is lower, even though irrigation application level is double. This highlights succinctly the level of loss of water to the plants in the development.

Trials Conclusion

Both trials areas were successful in proving Aqualatus could successfully be applied via irrigation to reduce the level of water required to grow plants. The level of -50% reduction was reached in 14 weeks however with moisture levels higher in the established area it is clear that 50% could have been reached earlier.

The virgin turfed area did take longer to reach optimal moisture content, this was due to the fact the area had never been irrigated prior to planting. Aqualatus in this instance would take longer to work as moisture levels needed to build underneath the root zone from a much lower level than the established area. This will be important when looking at commercial application for the region and could influence application rate going forward to accelerate efficacy.

For the AMWAJ Holiday destination, implementation of Aqualatus across the whole area would reduce water usage by 2,000,000 litres per day. Based on this, a saving in water of 730,000,000 litres per annum is proven along with saving 50% on nutrients and the energy to extract sea water, desalinate it and pump it to the irrigation system. It would also allow for a much larger area to be watered with the recycled water produced on site which would provide essential organic matter and extra nutrients to soils under the planted areas.

Business Case

The seawater is essentially free for AMWAJ apart for the cost of an extraction licence. The main cost is the energy use and cost of desalination through the reverse osmosis system.

The cost of desalination alone is £0.76 per cubic meter of water per day so current cost for AMWAJ per annum for this is £554,800 so saving 50% of this would be a saving of £277,400.

Cost of Aqualatus for the per annum for the whole of AMWAJ would be approximately £36,000 so the overall saving based solely on desalination cost would be £241,400 plus the saving in plant nutrition and the energy cost.

For more information on Aqualatus or any other products, contact us on

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