Scholarships

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**Peter Jones, made the most of his Ransomes Jacobsen scholarship and many nights of hard study was rewarded with a Master of Science Degree in Sports Surface Technology.**

# Keeping up with the Joneses

**It seems a long time ago now, since summer 2001 when I read details about the Master of Science degree in Sports Surface Technology that Cranfield University were going to run, and I can clearly remember making the decision that I would like to embark on the MSc course as my next challenge in both personal and professional development.**

**I discussed the course in more detail with Alex Vickers on the Cranfield University stand at the Saltex show, and made my application which was accepted on the merits on my experience, qualifications and references from David Golding, GTC, and Ken Richardson, BIGGA.**

Although the MSc can be taken as an intensive one year, full-time course, I decided to spread it over two years on a part time basis so that I could integrate it with my ongoing work commitments and family life, which includes two active nine year old sons.

In hindsight, spreading the course over three or more years on a part-time basis would have been an easier option in terms of time allocation, but none-the-less, I managed to complete it in two years and now have the benefit that it is finished and behind me.

Financial assistance with the cost of the course fees was offered in the first year with a half scholarship from the University itself, and in the second year I was successful with a grant from BIGGA through the Ransomes Jacobsen scholarship fund, for which I was most grateful.

I was particularly impressed by the course aims and objectives, and how the content of the MSc. course would relate to my work in the golf course industry. So right from the start I was self-motivated and determined to complete it successfully.

There are 11 modules to complete that run between October and May, and I attended alternate modules to complete six during the first year, and five during the second year. The other key requirements are two integrated end of year exams; a Thesis; and an oral examination, which takes the duration of the course through to a September finishing date.

**COURSE CONTENT**

SST Integrating Exam Paper 1
SST Integrating Exam Paper 2

**RESEARCH PROJECT THESIS AND ORAL EXAMINATION MODULES:**

- Soil Science
- Soil/Plant/Water Relationships
- Turfgrass Science and Technology
- Fundamental Plant Physiology & Biochemistry
- Drainage for Sports Surfaces
- Irrigation Management and Optimisation
- Mechanisation for Sports Surfaces
- Project Planning and Operations
- Sports Surface Playability
- Human Resource Management
- Management of Sports Facilities
- Sports Surface Construction (case study/ project based)

The delivery of the course combines a rigorous academic, technical and practical training that also incorporates an advanced level of business management skills.

Each module typically required block attendance at Silsoe campus attending lectures, carrying out research, literature reviews, and conducting practical work in the science laboratories. The modules themselves were marked by a combination of project assessments and exams.

In addition to the work on campus, there were organised visits to a range of sporting venues such as Wimbledon Tennis Club, Ipswich Town FC, STRI, Leeds FC trainings ground, Woburn G & CC, and Lords Cricket Ground (during reconstruction of the outfield). The field trips focussed on matters that related specifically to each module, with projects being set that required investigation and/or information to be gathered on each site.

**THE THESIS**

The MSc Thesis carries 40% of the overall course marks, and the research project I proposed was entitled:

AN INVESTIGATION TO DETERMINE WHETHER THE INCORPORATION OF ZEOLITE INTO SAND BASED ROOTZONE CONSTRUCTION MATERIALS BENEFITS GRASS QUALITY, GROWTH AND NUTRIENT RETENTION WITHOUT ADVERSELY AFFECTING DRAINAGE

As the mere length of the title might suggest, there was a lot of sampling and research to conduct, and the completed Thesis ran to two volumes, including 31 appendices detailing testing methods; analysis results; data sheets; and records of weather, irrigation & fertiliser applications.

The research project looked at whether the Cation Exchange Capacity (CEC) of USGA and sand-only rootzones could be significantly increased using an inorganic amendment, and whether turf quality and nutrient retention could be improved as a result of this, without impairing the drainage performance of the rootzone.

The amendment selected for use in the project was clinoptilolite zeolite with a hardness of moH 7, (comparable with quartz sand), and a particle size of more than 70% less than 100 microns diameter.

Zeolite is an inorganic material with a skeletal structure and the ability to absorb large quantities of ions and freely exchange them in solution.

One of the natural minerals in zeolite is clinoptilolite which is a crystalline alumino-silicate structure, and one gram of clinoptilolite provides up to several hundred square metres of internal surface area which can absorb an enormous quantity of cations including ammonium.

▲ **Figure 1: Raw clinoptilolite zeolite (0.25 – 1.00mm in size)**

The Cation exchange capacity of clinoptilolite is approximately 120 meq/100g, compared to sand which is typically 1-3 meq/100g. and therefore has a much, much better ability to retain nutrient ions for plant uptake, as opposed to being leached away.

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|---|---|---|---|---|---|---|---|
| K | 4 meq/100g | Mg | 18 meq/100g | Ca | 85 meq/100g | Na | 12 meq/100g |

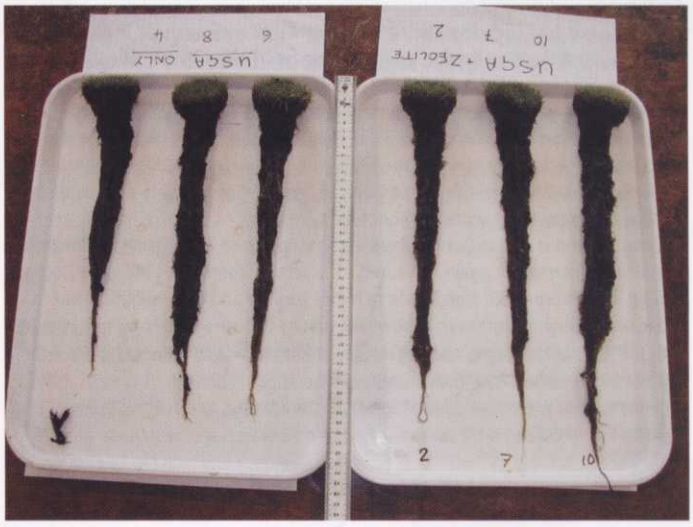
▲ **Table 1: Cations held within the raw material to make up the CEC:**

The clinoptilolite zeolite was mixed at 10% by volume with each of the two chosen rootzones, and 12 replicated randomised plots were set out so that there were:-

3no. plots constructed with sand only rootzone;
3no. plots constructed with a sand only plus 10% zeolite mixture; ,

3no. plots constructed with USGA only rootzone; ,
3no. plots constructed with a USGA plus 10% zeolite mixture.

The bulk of the research data was derived from sampling the rootzone material, grass clippings, and leachate collected from the 12 lysimeter plots which were constructed on site for the project. (A lysimeter is a tank system which enables the drainage water to be collected from each individual plot).



▲ **Figure 2: Root length – USGA (left), and USGA + Zeolite**

## ANALYSIS

The chosen methods to assess turf quality were: the measurement of colour (using a Minolta colorimeter); root length, root dry weight, and weekly measurements of grass clipping yield.

Analyses used to measure leachate was the measurement of NO3-N, NO4-N, P and K concentrations in the drainage leachate, using highly sophisticated electronic laboratory equipment.

Other analyses to compare treatment effects between the four rootzone mixtures included:

- Particle size distribution;
- Dry bulk density;
- Hydraulic conductivity;
- Available soil nutrient (P, K, Mg, S, Fe);
- Leaf tissue analysis (N, P, K, Mg, S, Ca, Mn);
- Soil pH;
- Organic matter content; and
- Cation exchange capacity.

Eight hypotheses were proposed for investigation in all, and the data collected from each of the testing methods was analysed using the multi sample analysis technique 'Two-way Factorial Analysis of Variance (ANOVA) with Replication' in Genstat (2001) software.

Finally, the 'Least significant difference' (LSD) statistical test was carried out, in order to determine whether treatment means were significantly different to each other.

The results chapter ran to 27 pages, and it would be difficult to provide a meaningful summary or conclusion within this short article.

Typically though, there were several measured improvements in the treatment plots that included the zeolite amendment, but almost all of these improvements were technically shown to be 'insignificant' when analysed statistically.

An example of this is shown below in relation to the hydraulic conductivity data:

Inspection of Figure 2, shows that the significant difference in mean hydraulic conductivity (Ksat) was between the two sand and the two USGA treatments, i.e. the significant difference in Ksat is a function of rootzone not zeolite amendment.

Figure 2. Histogram to show final field saturated hydraulic conductivity (m/day) for the four treatments. Error bars show the LSD at the 95% CI = 5.342 m/day.

Note: Treatments - left to right: Sand only S/O, Sand + Zeolite S/Z, USGA only U/O, and USGA + Zeolite U/Z.

These particular results therefore indicated that concerns over the possible loss of drainage performance due to Zeolite amendment were not founded at the 10% rate. (In fact the addition of the amendment was seen to improve the drainage performance).

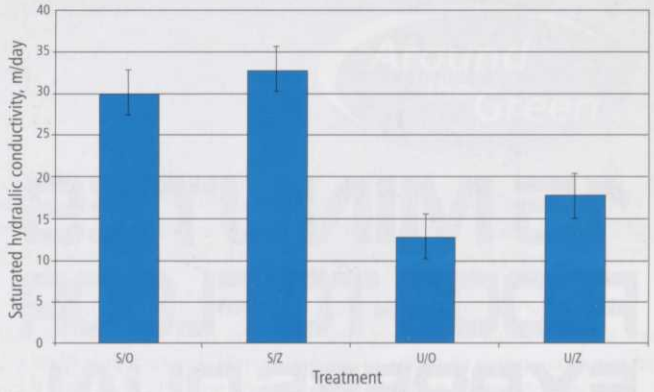



**Figure 2: Histogram**

For those who may be interested in more detail about the Thesis investigation, I have included the following abstract, and the complete Thesis is available for reference at the Cranfield University at Silsoe library. It is also my understanding that a paper will be forthcoming from the University in due course.

## ABSTRACT

The requirements of a modern golf green include good drainage and a resistance to compaction which has led to sand based constructions with sand being the major component within the rootzone construction mixture, however, the cation exchange capacity (CEC) of such rootzones is typically very low and nutrient retention is poor which could have a significant effect on the quality of the turf.

The addition of amendments into the rootzone mixture to increase the CEC may have the effect of reducing hydraulic conductivity which may compromise the drainage performance of the rootzone and be undesirable in design terms.

The research project aimed to investigate whether the incorporation of an inorganic amendment with high CEC would: i) significantly increase the CEC of the rootzone without significantly reducing the hydraulic conductivity, ii) show significant improvement in turf quality when compared to no added amendment, and iii) show measurable benefits of nutrient retention within the rootzone and a reduction in nutrient leachate within the drainage water.

An 'in-the-field' lysimeter experiment was conducted using grass plots sown with a traditional U.K. 80:20 ratio Festuca / Agrostis grass seed mixture, which was grown in sand only, and USGA mixture rootzones. Rootzones were amended with inorganic clinoptilolite zeolite at 10% by volume.

Soil analyses were conducted at the start and the end of the experiment, and measurements of grass quality were monitored over a 13 week period.

Data was gathered on: hydraulic conductivity, soil nutrient analysis, leaf tissue nutrient, root length and root weight, leaf colour, and nutrient leachate. Results were statistically analysed using analysis of variance (ANOVA).

The results showed that CEC was not significantly increased as a function of adding the amendment, but there was a significant increase between the sand without amendment and the USGA with amendment.

Hydraulic conductivity and dry bulk density was not significantly changed, but Ksat did increase and the dry bulk density decreased, when amendment was added.

There was no significant improvement in turf quality based on the methods of assessment used, which raised a number of queries in relation to more complex factors and variables that effect turf growth, and the limited duration of the research.

Other significant results included evidence of much higher levels of Iron (Fe) within the leaf tissue of the non amended sand only treatment, and a reduction in Potassium (K) leachate within the drainage of the amended treatments.

## WHAT DID I GAIN FROM THE MSC LEARNING EXPERIENCE?

I had a great sense of personal achievement when I was finally telephoned by Alex Vickers and told about my degree award, and after two years hard slog, I can now look forward to a year with a lot less time spent with my head buried in books, and a lot more time back out on golf courses doing my advisory work.

Coming from a practical background, I feel that I will have the ability to apply a lot of what I learnt to practical situations in the field, which I think will therefore be of benefit to the greenkeepers, turf managers and clients that I work with.

I am very grateful to BIGGA and Ransomes Jacobsen for their help through the scholarship fund, and especially grateful to my family for their patience and support over the past two years.

Looking back on the whole learning experience, it was certainly a challenge, but one made all the more rewarding by the people I met and got to know. I liked the time flexibility of modular system and the variety of subject areas covered within the course. My top tip for anyone contemplating the MSc course would be to choose a less complicated Thesis project than I did - but as we know hindsight is a wonderful thing!