# VIEBAND SAND

Supplying from tee to green

**The Scientific Approach to Selecting Sand**

**And**

**Building Golf Greens, Tees, Bowling Greens and Sportsfields**

**Why this Booklet ?**

For many years the turf industry has resisted the move towards sand construction and continued the use of old methods such as sand and soil blends.

Recently the Vieband sand company has secured a long term supply of U.S.G.A. grade sand on the north coast of New South Wales. A recent survey of this deposit has estimated the site to have 10 to 15 million tonnes of sand which will be available for the turf industry over the next 30 years.

This material is a high quality sand that can be used for golf greens, tees, bowling greens and first class sportsgrounds. Vieband has decided to undertake a scientific approach to the marketing of its products by providing you the customer with the real facts about their products based on independent scientific analysis and their interpretation from two well known and respected identities in the turf industry, **Dr Bent Jakobsen from Rootzone Laboratories in Canberra and Keith McIntyre from Horticultural Engineering Consultancy in Canberra.**

Dr Bent Jakobsen is Australia's leading sportsturf soil physicist and together with Keith McIntyre have written the book ***Drainage for Sportsturf and Horticulture,*** which is the leading text on this subject in Australia.

Vieband has decided to take a scientific approach to counter the various rumours and misunderstanding of sand construction methods as well as setting an industry standard for the selection of sands for sports facilities in our industry.

Vieband has employed a professional writer to prepare this booklet based on the information supplied from a number of sources.

When considering a rootzone mix for your next project, managers should compare products based upon independent scientific information from soil analysis and not second hand information obtained from an unreliable source. Ask the question “is the other product information based on good soil science, or is it just sales talk?”

## What is Vieband WM Sand ?

The Vieband WM Sand comes from a unique sand deposit which is located 150kms north of Sydney. This sand deposit contains approximately 10 to 15 million tonnes of USGA grade sand, with test results indicating very little variation within this huge deposit. Unlike other deposits being mined such as river deposits and small land diggings, this sand deposit will not run out in your lifetime as a superintendent or grounds manager.

Let us have a look at the properties of the Vieband WM Sand and compare them scientifically with the highest industry standards.

The first standard that everybody wants their sand to meet is the USGA (United States Golf Association) for rootzone mix. This is recorded in the USGA Green Section Record, May April 1993. It specifies a range of properties which include the following: Particle Size Distribution; Porosity; and Hydraulic Conductivity.

Let us now compare the Vieband WM Sand to the USGA specification for a particle Size Distribution which is as follows:

**Particle Size Distribution of USGA Root Zone Mix**

| Name | Particle Diameter | Recommendation (by weight) |
|---|---|---|
| Fine Gravel | 2.0 - 3.4 mm | Not more than 10% of the particles in this range including a maximum of 3% fine gravel (preferably none). |
| Very coarse sand | 1.0 - 2.0 mm | |
| Coarse sand | 0.5 - 1.0 mm | Minimum of 60% of the particles must Fall in this range |
| Medium sand | 0.25 - 0.50 mm | |
| Fine Sand | 0.15 - 0.25 mm | Not more than 20% of the particles may fall within this range |
| Very Fine sand | 0.05 - 0.15 mm | Not more than 5% |
| Silt | 0.002 - 0.05 nun | Not more than 5% Total particles in this range shall not exceed 10% |
| Clay | < 0.002 mm | Not more than 3% |

The USGA Specification also requires the Total Porosity to be between 35 - 55%.

The particle size distribution for 8 samples of Vieband WM Sand that have been tested by Rootzone Laboratories International in Canberra, Turf Technology in Melbourne, and by Coffey Partners in Sydney are shown in the following table:

| **Particle Size Analyses for Vieband WM Sand % by weight** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sieve Sizes In mm | Sample **1** | Sample **2** | Sample **3** | Sample **4** | Sample **5** | Sample **6** | Sample **7** | Sample **8** |
| >2.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.0 -2.0 | 0 | 1,0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0.5-1.0 | 2.1 | 1.1 | 2.0 | 0.5 | 1.5 | 1.0 | 1.0 | 1.9 |
| 0.25-0.5 | 89.0 | 85.5 | 87.0 | 87.5 | 81.9 | 84.5 | 84.5 | 84.4 |
| 0.1-0.05 | 9.9 | 13.3 | 11.0 | 13.0 | 16.3 | 14.2 | 14.4 | 13.5 |
| 0.05-0.01 | 0 | 0 | 0.6 | 0 | 0.1 | 0.1 | 0.1 | 0.1 |
| 0.01-0.002 | 0 | 0 | 0 | 0 | 0.2 | 0.1 | 0.1 | 0.1 |
| <0.002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Porosity | 42% | 37%% | 42% | 43% | 43% | - | - | - |

**Table 1 shows the Particle Size Distribution for eight samples of Vieband WM Sand carried out over the past four years. Total porosity is also shown for several samples.**

All of the samples meet the USGA specifications.

## P Type Sand

The Technical Services Unit in Canberra where Dr Bent Jakobsen and Keith McIntyre worked for many years developed a specification for sands for golf greens, bowling greens, and elite sports grounds. Their specification is called the P Type sand, and it is a refinement on the USGA specification which they found to be too broad.

The P Type sand specification is within the USGA specification, and it can be said that this is the ideal USGA Sand. The P type specification allows fewer fines, fewer coarse particles, and requires more particles to be in the 0.25-0.5mm range. However we stress that **it is still within the USGA range, - a P type sand is still a USGA sand..**

## P Type Specification

The following is the full P Type specification

### 1. Particle Size Analysis

| USGA Sieves | % Retained by weight | |
|---|---|---|
| > 2.00mm | 0 | |
| 1.0-2.0mm | 0-10 | |
| 0.5-1.0mm | 0-20 | |
| 0.25-0.5 | 55-90 | ***** |
| 0.1-0.25mm | < 20 | üMaximum combined |
| < 0.1mm | 0-10 | ýproportion of these |
| <0.002mm(clay) | 0-4 | þfractions shall not exceed 25% |

If a sand has more than 90% in this range it must have proven stability.

### 2. Compacted Hydraulic Conductivity

At 16 drops must exceed 700mm per hr

### 3. Bulk Density

At 16 drops must not exceed 1.58

**4. Acid Soluble Material**

There should be less than 5% of any material that will be dissolved in hydrochloric acid.

**5. Moisture Release Curve of the Sand**

Two moisture release curves are made, one at low compaction, and the other at high compaction, and if there is a significant difference in the shape of the two curves, then the sand will be rejected as it will cause different properties in the green at different locations on the green.

**How does Vieband WM Sand match up to the P Type Specification ?**

The Vieband WM Sand is compared with the P Type specification in the following table. Remember that the P Type specification is a high standard than the USGA specification.

| P Type Sand Specification | P Type Specification | | | Vieband WM Sand Test Results Average of the 8 tests in Table 1 |
|---|---|---|---|---|
| **Particle Size Distribution** | > 2.00mm<br>1.0-2.0mm<br>0.5-1.0mm<br>0.25-0.5<br>0.1-0.25mm<br>< 0.1mm<br><0.002mm (clay) | 0<br>0-10<br>0-20<br>55-90 *****<br>< 20<br>0-10<br>0-4 | ü Max combined<br>ý proportion of these<br>þ fractions shall not exceed 25% | 0<br>0<br>0.1<br>1.3<br>85.5<br>13.2<br>0.1<br>0<br>0 |
| **Hydraulic Conductivity** | At 16 drops must exceed 700mm per hr | | | Meets specification >1,000mm/hr |
| **Bulk Density** | At 16 drops must not exceed 1.58g/$c^3$ | | | Meets specification 1.54 g/$c^3$ |
| **Acid Soluble Material** | There should be less than 5% of any material that will be dissolved in hydrochloric acid. | | | Meets specification 0% Soluble |
| **Divergence of Moisture Release Curves** | Moisture release curves must not diverge significantly at high and low compaction | | | Meets spec. almost no divergence |

**Table 2 shows how the Vieband WM Sand meets the P Type Specification. The average of eight Particle Size Distribution tests from Table 1 was used, and data on bulk density, Hydraulic Conductivity, Acid Soluble Material, and Moisture Release Curves which were carried out on some of the eight samples.**

## Does Vieband WM Sand meet the P Type Specification ?

**1 Particle Size Distribution**

Meets the specification.

**2. Compacted Hydraulic Conductivity**

Meets the specification.

At 16 drops all sand tested exceeded 1,000mm/hr, some samples exceeded 1600mm/hr.

**3**. **Bulk Density**
Meets the specification
At 16 drops all samples tested were less than 1.58g/cm$^3$

**4.** **Acid Soluble Material**
No samples tested showed any acid soluble material.

**5.** **Moisture Release Curve of the Sand**
In samples where the moisture release curves were generated the two curves were almost identical, indicating an excellent sand.

## Stability

There has been some misinformation circulating within the industry that Vieband WM Sand is unstable because it is such a uniform sand with about 90% of its particles in the 0.25-0.5mm range. Let us look at the stability of sands, what makes them more or less stable, and how can this be tested scientifically.

If the outside of a sand particle is rounded and smooth, then when the sand particles rub against each other there is little friction and they roll, causing instability. The analogy most used is a jar full of marbles, when you push your hand into it they simply roll out of the way as they are displaced easily. This effect is accentuated if the particles or marbles are all the same size.

If there is a range of particle sizes, then the smaller ones fit in between the larger ones in the voids, and this tends to lock all of the particles together and significantly reduce the tendency for displacement. If the sand particles are sharp and angular this further reduces the tendency for displacement and makes the material more stable when pressure is applied eg. by someone running on it or jumping onto it.

If there is too wide a range of particles the material can become dense as all of the larger voids are filled up with smaller particles and this has two effects. Firstly it becomes very hard - its bulk density increases, and secondly its hydraulic conductivity is reduced because water has a much more tortuous pathway to travel through the sand.

For these two reasons the specifications of the sands specify a minimum hydraulic conductivity, which ensures that there are sufficient large voids within the sand, and a maximum bulk density at a given compaction level is specified. This ensures that the sand will not become too hard.

When all of these qualities are put together the only sands that meet all of these specifications are those which have in excess of about 55% in the 0.25-0.5mm range, as well as not having too many fine particles. If these sands have too many coarse particles they also become less stable.

We consider that the best way to counter this misinformation about Vieband WM Sand is to provide scientific proof about our sand, and challenge others to do the same with their sand.

### Stability Test

Dr Bent Jakobsen at Rootzone Laboratories International in Canberra has developed a test to determine the comparative stability of sands, and this is called the Drop Cone Test.

At the time of testing the sand must be at field capacity, ie. at one metre suction water content. Samples of the sand are prepared at different levels of compaction, most particularly at 16 and 32 drops which represent medium to heavy sporting use. A standard stainless steel cone is dropped into the sand samples from a known height, and the depth to which the cone penetrates the sand is measured. From these results a calculation is made which represents the relative stability of the sand at the two different compactions.

If the sand is unstable, when the cone enters it at a standard velocity, the sand particles will be displaced sideways and the cone will penetrate deeper into the sand. The higher the number, the more stable the sand.

As outlined above the usual reason these types of sands get their stability is because there are different sized particles, some small, some larger, and the smaller particles tend to lock into the voids and make the sand more stable.

Vieband WM Sand has a very high percentage in the 0.25-0.5mm range (around 85%) and some are assuming that because there are so many particles in the one range that the product will be unstable, based on the one sized marble example. If the sand particles themselves were simply round and smooth this theory would hold up, and the sand would probably be quite unstable.

The Vieband WM Sand was tested against four other sands being used in the Sydney district, which also passed the P Type sand particle size analysis, and the results are summarised in the following table.

| **Particle size** | **Sand A**<br>**% by wt.** | **Sand B**<br>**% by wt** | **Sand C**<br>**% by wt** | **Sand D**<br>**% by wt** | Vieband Sand<br>% by wt |
|---|---|---|---|---|---|
| > 2.0mm | 0 | 0 | 0 | | **0** |
| 1.0-2.0mm | 0.6 | 0.5 | 0.2 | 1.9 | **0.1** |
| 0.5-1.0mm | 9.2 | 13.2 | 11.8 | 18.0 | **1.3** |
| 0.25-0.5mm | 69.4 | 66.8 | 67.5 | 62.2 | **85.5** |
| 0.10- 0.25mm | 19.1 | 17.6 | 19.5 | 16.9 | **13.2** |
| <0.10mm | 0.9 | 1.9 | 1.0 | 1.0 | **0.1** |
| Stability 16 drops | 8.33 | 9.83 | 7.37 | 11.68 | **9.55** |
| Reading 32 drops | 5.26 | 6.01 | 4.56 | 8.1 | **6.2** |

**Table 3 shows Vieband WM Sand compared to four other sands from the Sydney district which meet the P Type specification. Their stability numbers are shown for 16 drops and 32 drops.**

The stability numbers from the table above show that the Vieband WM Sand was the second best sand at the highest compaction, and third best at the medium compaction. This clearly indicates that Vieband WM Sand is a stable sand, and compares very favourably. These results clearly indicate that the fact that it has in excess of 85% of particles in the 0.25-0.5mm range does **NOT** make it less stable than those with a wider particle size distribution.

As you can see from the above tests the Vieband WM Sand is more stable than most of the other good sands used for greens construction.

## Why is Vieband WM Sand Stable ?

Whilst Vieband WM Sand has a high percentage of particles in the 0.25-0.5mm range it is not unstable for two reasons. Firstly when the particles between 0.25-0.5mm were further analysed by separating the 85.5% of particles out further by adding two more sieves (0.3mm, and 0.45mm) it was found that there was the following particle distribution within this range:

| | |
|---|---|
| 0.45-0.5mm | 9.2% |
| 0.3-0.45mm | 56.0% |
| 0.25-0.3mm | 20.3% |

This shows that there is a range of particles within this range and this helps them to fit together more tightly.

The second factor which makes Vieband WM Sand very stable is the characteristics of the outside of the sand granules themselves. When the sand granules are observed under the microscope the outside of almost all granules is abraded, as though it had been lightly sanded.

When these roughened particles rub against one another there is friction which causes a resistance to movement. So when pressure is applied by foot traffic the sand particles do not move aside as easily as other particles which may be smoother on the surface.
It is like the difference between rubbing two sheets of glossy paper together compared to rubbing two sheets of fine sandpaper together.

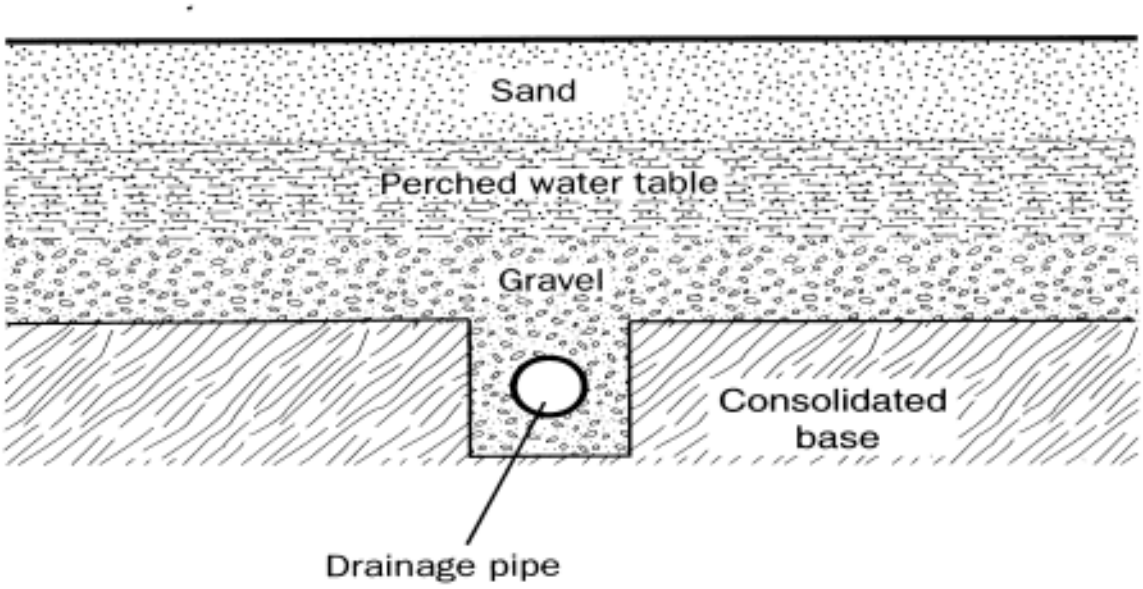
This exterior roughness of the sand particles gives this sand a stability factor equal to other sands which have smoother surfaces, but with wider particle size distribution.

A good example of this sands stability is Parramatta Stadium which was built with a sand from the same deposit which had the same particle size distribution. There has never been a complaint about the stability of this facility.

**When you are building a golf green, a golf tee, or a bowling green with Vieband WM Sand, how deep should the profile be ?**

**High Draining High Performance Golf Greens and Bowling Greens**

To construct a perched water table green using Vieband WM Sand and Vieband Gravel the profile should be as follows:



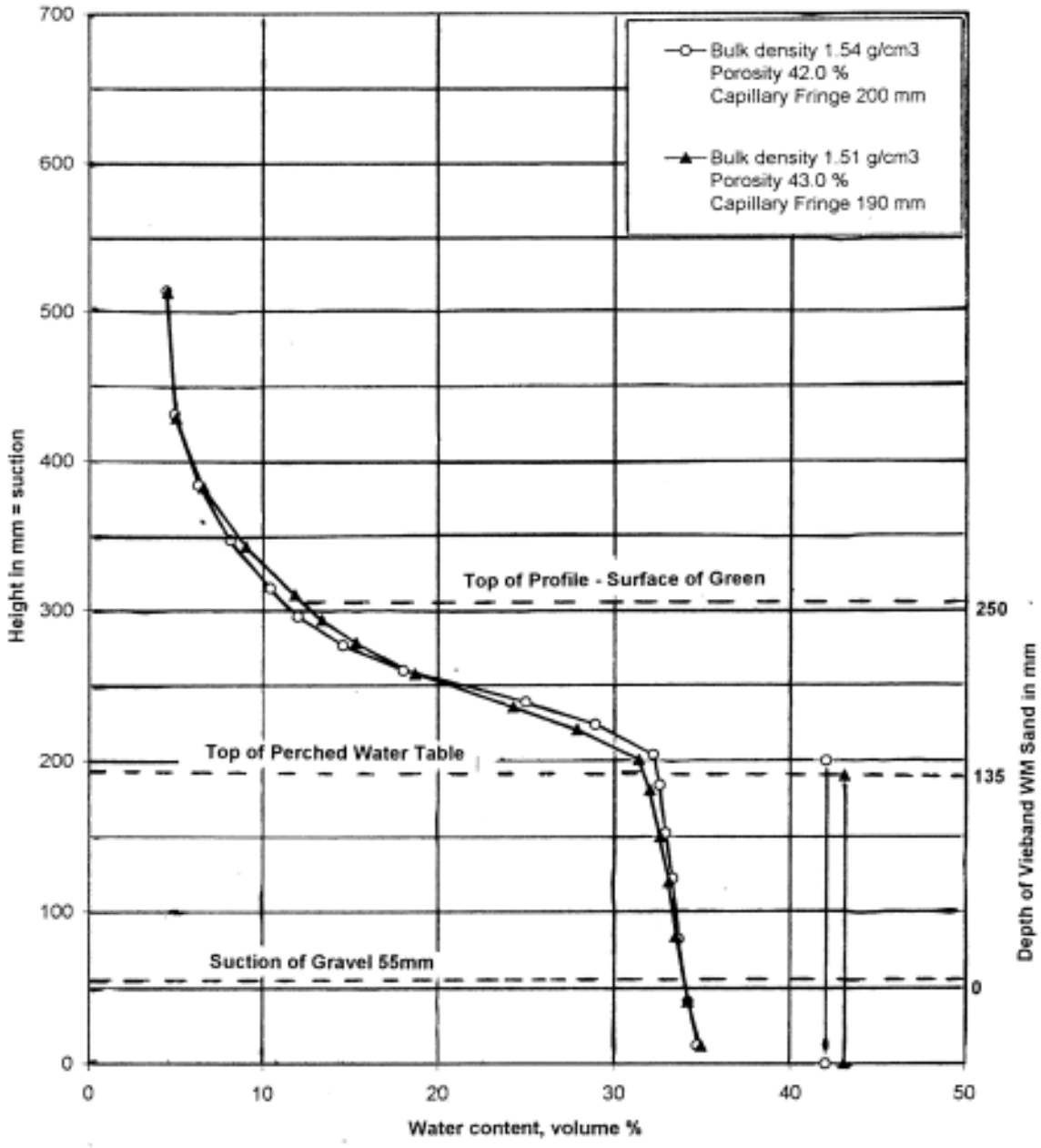

| | |
|---|---|
| Top sand layer | 250mm |
| Gravel Layer | 100mm |
| Drain Spacings | 4-4.5m apart |

## Why this Depth of Profile, and Not 300mm?

The depth of the profile should be arrived in the following way:

1. First select your sand for the growing medium, in this case Vieband WM Sand.
2. Have a moisture release curve done on the sand. (The moisture release curve for the Vieband WM Sand is shown on page 10).
3. Then select a compatible gravel and have its suction determined, as the depth of the perched water table will be reduced by the suction of the gravel. (Vieband Gravel has a suction of 55mm).

## Moisture Release Curve for Vieband WM Sand


Bulk density 1.54 g/cm3
Porosity 42.0 %
Capillary Fringe 200 mm
Bulk density 1.51 g/cm3
Porosity 43.0 %
Capillary Fringe 190 mm
Top of Profile - Surface of Green
Top of Perched Water Table
Suction of Gravel 55mm
Height in mm = suction
Depth of Vieband WM Sand in mm
Water content, volume %
700
600
500
400
300
200
100
0
0
10
20
30
40
50
250
135
0

From this curve we can see that the depth of the perched water table is 200mm, but when we subtract the suction of the gravel it will be 145mm when the Vieband WM Sand is placed over Vieband Gravel.

At a sand depth of 250mm, the moisture content at the top of the profile will be about 8-9%, but the top 50mm would have an average water content of about 10%.

If the Vieband WM Sand depth was increased to 300mm, the moisture content at the surface would be only about 6% and the top 50mm would have a moisture content of only about 7.5%. This is very low and could lead to Dry Patch, as well as making the greens very difficult to manage in the summer time as there is insufficient water for the majority of roots.

There is a second good reason for beginning with 250mm of topsand. Over the years the depth of topsand will build up with topdressing, and this effectively decreases the water holding capacity of the top 50mm where the majority of grass roots are. It also means that the roots only have to be 100mm deep to access the perched water table.

By using the correct depth of topsand - 250mm instead of 300mm, you save a considerable amount of money. For a 600m$^2$ green the volume of sand used if the sand is 300mm deep would be 180 cubic metres, (288 tonnes), but you only need 150 cubic metres (240 tonnes) at 250mm.

**You are paying less for a better profile and a green that will be less prone to Dry Patch.**

**Should you Use an Organic Amendment such as Cocopeat in the Top of the Profile?**

The answer is yes, and the reason for using it is simple. When you look at the moisture content at the top of the profile at 10% it is low, and needs to be raised to about 14-15%.

If Cocopeat is used at 10% by volume the water content of a 250mm profile would be raised to an acceptable level.

If you insist on making your sand depth 300mm, then the impact of the top drying out and being difficult to manage will be reduced by incorporating 20% by volume of Cocopeat. This extra amendment only serves to allow the top 50mm to hold more water. The great disadvantage with this deeper profile is the roots have to be in excess of 150mm long to be able to access the perched water table, and this is very unlikely in most situations. It simply means that the water stored in the perched water table is completely wasted.

## How Much of the Profile Should Contain Cocopeat?

Peatmoss or any organic amendment should only be incorporated into the top 100mm of the sand. There are several good reasons why this should be so. Firstly, this is the sand which is not saturated within the profile, and therefore the water holding capacity can be increased, this is very important in the first twelve months when establishing the new grass. After a number of years the Cocopeat will begin to break down and disappear, but will be replaced by old grass roots which have died and then form organic matter in this part of the profile.

The Cocopeat or peatmoss has a relatively high cation exchange capacity, and holds Potassium, Calcium, and Magnesium in the rootzone. If the peat is mixed through the whole profile, any nutrients held on the material below the root system are not available to the plant anyway, so there is no nutrient advantage.

There is also no water holding advantage in having peat in the saturated part of the profile, as it does not add to the available water to the grass.

**Disadvantages of Having Organic Material through the whole of the Sand Profile**

The USGA specification does specify to have the organic amendment blended throughout the whole profile but Dr Bent Jakobsen and Keith McIntyre are not in favour for this method as explained below.

If the organic material is in the saturated perched water table in the bottom 150mm of the profile, the conditions down there are close to anaerobic, and if other conditions are not correct Black Layer may form. This is a black slimy smelly layer that can form in sand profiles and it will severely reduce drainage.

## Why not use Chicken Manure?

Chicken manure is not recognised as a long term moisture holding material. It is generally used as a short term fertiliser. This product can be highly variable in its organic, nitrogen and sulphur contents. It rarely lasts very long in the profile and most of its water holding capacity is quickly lost.

Whilst chicken manure has some nutrients of its own it has far less nutrient holding capacity than Cocopeat or peatmoss.

This material can add greatly to the potential of Black Layer particularly if it is through the whole profile.

The most telling reason as to why you should not put organic matter throughout the whole profile is cost. Why spend money putting a material into 60% of the profile when there is no water holding or nutrient advantage to the grass.

## Mixing of Organic Material into Sand

Organic material should ***not*** be mixed by rotary hoeing it into the top of the green as this will lead to a very uneven distribution of the material throughout the profile. In some areas the mixture could be 200mm deep and in others it could be 100mm. This leads to differing nutrient and water contents, and this will be reflected in uneven root growth.

Mix your organic amendment such as Cocopeat, peatmoss (or if you must) chicken manure into the sand at the quarry source by the supplier. This way the organic mix will be more uniform and you will be able to spread the blend more accurately and be assured of a high quality profile throughout the green.

The money you save by having a Vieband 250mm profile, and only organic material in the top 100mm will allow you to do the job properly in two layers for the same cost.

## Does having Organic Amendment only in the top 100mm effect the grass growth or the playability of the green?

No. There are many fine golf and bowling greens constructed using this method with profiles of less than 300mm and organic material only in the top 100mm. These are in South Australia, New south Wales, ACT and Victoria.

The profiles are deep enough for hole changes, and the roots do penetrate deeper than the top 100mm at various times of the year. Remember if the profile depth is correct the roots reach the perched water table anyway and do not need the extra water holding capacity.

Almost all of Australia's main stadiums have been built using these principles. These include MCG, Parramatta Stadium, Stadium Australia, Sydney Showground, Bruce Stadium, ANZ, Suncorp, Stockland Stadium. All of these facilities grow good grass and drain very well.

## How to build Golf Tees with Vieband WM Sand

Excellent golf tees can be constructed by using the Vieband WM Sand. The best method is to construct the tee the same way as the green, with a 250mm layer of sand over a 100mm gravel layer with drainage pipes at 4m spacings. They will drain at around 200mm /hr, and will always grow good grass.

If this is considered too elaborate then there are two other alternatives.

**Option 1.**

High quality tees can be attained using the following method:

Consolidate the base to reduce drainage down through it. Install sub-soil drains surrounded with Vieband Gravel, at 4m spacings into the base, then lay 100mm Vieband gravel with the gravel surface parallel to the proposed finished surface. Then place 250mm of Vieband WM Sand over the gravel. Turf with washed turf or stolonise. If using turf it must be washed as even small amounts of soil on the turf will reduce the drainage rate dramatically.

If 15% by volume of Cocopeat is added to the top 100mm of the profile it will improve the water holding capacity and the nutrient retention of the tees a great deal.

These tees will grow good grass and drain in excess of 200mm/hr.

**Option 2.**

Consolidate the base to reduce drainage down through it. Install sub-soil drains surrounded with Vieband Gravel, at 2m spacings into the base, then lay 275-300mm of Vieband WM Sand over the top and turf with washed turf or stolonise. If using turf it must be washed as even small amounts of soil on the turf will reduce the drainage rate dramatically.

A better result will be achieved if the top 100mm has Cocopeat or peatmoss in it as above.

These tees will grow good grass and drain at about 40mm/hr.

**Option 3.**

Use a base that drains slowly, ie. one that has only been uniformly lightly consolidated. Install drains at 2m as above but only lay the sand 250mm deep. The base may drain at approximately 5mm/hr which means that natural drainage will dry the top 50mm of the tee to about 10% in about 4-5 hours. This means in summer time the top of the tee will become very dry, as the grass will be struggling to get enough water. There is definitely a need to have Cocopeat or peatmoss in the top 100-150mm of this profile.

This is the least desirable of the three methods, even though it is the cheapest.

**How to Fertilise New Sand Profiles**

Many people are concerned that if they change to sand greens they will use a great deal more fertiliser. The management of sand greens does involve the use of more fertiliser than conventional soil greens, but there are other considerations and cost savings that are associated with sand greens.

They drain extremely well and can withstand much more wear. If water is managed properly they can actually use less water than conventional greens. They require very little decompaction and properly managed will give you better play for longer periods.

There does however need to be a change in your approach and understanding to fertilising and general nutrition. The most important change is in Phosphorus nutrition. In soil Phosphorus is quickly adsorbed onto the soil particles and this is available to the plant for a long period of time, hence it is normal practice to only add phosphorus when the soil needs it and even then small amounts go a long way. We are also aware that high P levels will favour Winter Grass.

On sand profiles the situation is completely different as there are no sites within the profile for P to be held, as sand does not adsorb P and Peat or other organic materials usually only adsorb cations (K, Ca, Mg, Na). Phosphorus therefore is quickly lost out of a sand profile by leaching and must be replaced very regularly. There is almost no chance for a high P level to exist in a sand profile for any period of time, so the worry about high P and Winter Grass does not exist.

Phosphorus should be added every couple of weeks in small amounts, as there is no advantage in adding "normal" doses as the majority will be simply washed out the bottom of the profile.
Other nutrients such as K, Ca, Mg, and Ammonium ions are retained on the organic matter and are available to the grass for longer periods. These elements are available in slow release form and last even longer than the normal soluble products.

However the principle of small amounts of all regularly is important in managing sand profiles economically.

**Establishing Grass on Sand Profiles**

If turf is being used, then it must be washed turf, and this has no soil to hold nutrients. It is extremely important to ensure that the Phosphorus supply is regular and adequate in the first three months. P is essential for the growth of roots, so apply it every two weeks.

Other essential nutrients should also be applied regularly based on the grasses needs.

**Addition of Organic Fertilisers**

There are a number of organic 'fertilisers' which greatly enhance root growth, and these include the seaweed derivatives such as Naturakelp and Arcadian which stimulate root growth. They also probably increase the microflora in the vicinity of the roots which assists in resistance to disease, and increases the uptake of other nutrients.

Products such as molasses derivatives also assist in increasing microflora and improving root growth.

We would recommend the use of these products on sand profiles.

**Observe Roots as well as Leaves**

Many turf managers only asses the condition of their grass by how the surface looks, ie. Colour and vigour of the above ground part of the plant. On sand profile it is probably more important to regularly take cores (every week or two), and observe the condition and depth of the roots. If they are fat and white then everything is OK, but as soon as they begin to go brown and become thin there is something not right. It may be lack of P, or Nematodes or other disease. Often the roots can be in this state for a couple of weeks and the surface grass is still in good condition, then the problem suddenly hits the whole green. These things can happen quickly on sand greens, but by regularly observing the roots they can be detected early.

Good root management is the key to sand profile management.

**Water Management**

Sand greens need to be watered carefully and over watering should be avoided as it simply wastes nutrients. If you are watering so that there is a lot of water running out of your drains then you are over watering.

Sand greens are different to manage, but they are more rewarding as they can be used much more without damage, and they drain superbly.