Rootzone Materials for Athletic Fields in the United Kingdom

By Dr. Stephen Baker

Although USGA rootzone recommendations are widely used for golf green construction in the United Kingdom, for athletic fields the criteria for rootzone selection are somewhat different. Athletic fields, or what we would normally call winter games pitches, are mainly used for the sports of soccer, rugby and field hockey. As the name implies, these sports are played predominantly through the winter months, starting in the fall and finishing in the spring. For much of this period, rainfall greatly exceeds evapotranspiration and therefore good drainage is essential. In addition, temperatures and light levels are such that grass growth is very limited between November and March. These two factors have a major influence on the selection of rootzone materials for athletic fields; high sand contents are needed to ensure good drainage and adequate amounts of air-filled pore space.

On the other hand, in the absence of continued growth, grass cover will be lost on the more intensively used areas (eg. soccer goalmouths) and therefore finer sands are used to retain stability.

Research trials

It would be misleading to imply that all rootzones in the United Kingdom are based on sand-dominated materials. Indeed, the majority of public sector pitches are based on the native soil with pipe drainage and sometimes still drainage being installed. However, at the main stadiums used for professional sports, sand-dominated rootzones are now always used.

The selection of materials has been based on a considerable amount of research work over the last 20 years. One of the most significant early trials was a study that ran from 1984 to 1987. In this study, we examined 16 rootzone materials formed using four contrasting sands and four mixing ratios of sand to sandy loam soil. The sands were a medium-fine sand, a medium sand, a medium-course sand and a fourth sand with a very wide spread of particle sizes. The four mixing ratios ranged from a mix of 1 part sand to 2 parts soil to pure sand rootzones. In profile, the construction consisted of a 150 mm thick gravel drainage layer with pipe drains, a 50 mm blinding or intermediate layer of predominantly 0.25-2.00 mm grit and 250 mm of the rootzone material. All the experimental plots were replicated four times and the trial was sown with perennial ryegrass in July 1984.

All our trials of this nature received simulated wear using a differential slip wear machine, developed to replicate the compacting and tearing forces imposed by play. These treatments were applied throughout the main playing season (late August to the end of April) for three years. The measurement program included assessments of soil properties (water infiltration rates and levels of compaction), changes in grass cover and the playing quality of the surface (ball rebound, ball roll, hardness and traction or grip).

A summary of the main findings is as follows:

- Drainage rates and the amount of air-filled pore space increased with sand content and at least 90 percent sand-sized particles and preferably 95 percent were needed to ensure satisfactory soil physical properties after wear.
- The retention of grass cover during wear was greater on the sand-dominated rootzones. In the final season for the trial, ground cover after five month's wear varied from 8 percent on the mixes with the highest soil content

TABLE 1
Preferred range for sands for use in athletic field rootzones in the United Kingdom (Baker 1990)

Particle size (mm)	Percent passing by weight
2.0	100
1.0	98-100
0.5	75-100
0.25	20-65
0.125	0-5
0.063	0-2

For rootzone mixes, we also have guidelines for the physical properties after compaction in the laboratory. These also are similar to USGA figures except that only the minimum requirements are given.

Hydraulic conductivity = 150 mm/hr
Total porosity = 33 percent
Air-filled porosity = 15 percent
Capillary porosity = 15 percent

to 45 percent on the pure sand rootzones.

• Playing quality was more consistent on the rootzones with high sand contents. On the soil-dominated rootzones, the surface was very soft and ball rebound low in wet winter weather but at the end of the playing season, when grass cover had been lost, the soil-dominated rootzones could be excessively hard.

• Sand type also had significant effects on soil physical properties. The coarser sands gave higher drainage rates and more air-filled pore space but featured lower levels of moisture retention.

• Where the sand had a wide spread of particles, it tended to become more compact because of interpacking, and hardness values were generally increased.

• For playing quality, the most important fact was that traction values were considerably lower when medium-coarse sands were used.

A further study in the late 1980s and early 1990s examined rootzone performance on real pitches receiving different intensities of use. Although pure sand rootzones had many advantages in terms of soil physical properties, they became very difficult to manage toward the end of the season as grass cover was lost through wear. Erosion hollows tended to develop on the intensively used parts of pitches. Although watering and rolling could be used to restore the stability of the otherwise loose sand, the high management input made pure sand constructions uneconomical.

Recommended size gradings

In 1990, the STRI published guidelines for Sands for Sports Turf Construction and Maintenance (S.W. Baker, 1990, 58 pages). This gave preferred and acceptable particle size gradings for a number of applications including sands for athletic fields and golf green rootzones, slit drainage and golf bunkers. The preferred and acceptable ranges for sands for use in athletic field rootzones are given in Table 1.

Future changes in rootzone materials

The main reason for selecting medium-fine rootzone mixes for athletic fields, compared to the medium-coarse mixes used for golf green construction, has been because of the potential problem of stability following ground cover loss through winter play. Two factors are now helping to address stability problems. Firstly, reinforcement materials in the form of polypropylene fibers either mixed or punched into the rootzone are quite widely used at our major sporting venues. Secondly, techniques for sod replacement for high wear areas of athletic fields have been greatly improved and in many stadiums the turf in goalmouths in particular is replaced during the playing season. Accordingly, there has been a recent trend at such sites to move from a medium-fine sand to a medium sand as the main component of rootzone mixes. This helps guarantee better drainage and usually promotes better root development, both important factors in the provision of rootzone materials for modern sporting venues.

Dr. Stephen Baker is the head of soils and sports surface science at the Sports Turf Research Institute in West Yorkshire, England.

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