The maintenance of performance in synthetic turf sports surfaces

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Centre for Sports Surface Technology

IOG
THE INSTITUTE OF GROUNDSMANSHIP 2012 Fund

EPSRC
Engineering and Physical Sciences Research Council
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The key issue

- If left unmaintained synthetic turf pitch performance will decline at a rate controlled by:
  - Manufacturing
  - Installation
  - Usage
  - Environment
• Q1: What effect on playability does pitch deterioration have?

• Q2: How should pitches be maintained?
• Research project 2003 – 2008 funded by the Institute of Groundsmanship and the UK Engineering and Physical Sciences Research Council

• Aim:
  • Produce guidelines, based on research, for IOG members having to maintain an increasing number of synthetic pitches

• Focus: 2G sand-filled surfaces
Survey

- Average annual maintenance expenditure per pitch:
  - Synthetic: £ 8000
  - Natural turf: £ 7500

- Average weekly usage:
  - Synthetic: 44 h
  - Natural turf: 4.1 h

- Average annual maintenance expenditure per hour of use:
  - Synthetic: 3.49 £/h
  - Natural turf: 35 £/h
Water flow Pathway

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Obstruction 1: Surface degradation
Fibrillation and capping

- Tufted fibres
- Rounded sand infill
- Carpet backing
- Drainage holes
- Fibrillated and capped fibres

25 mm
Obstruction 2: Infill contamination
Infill and contamination
'Field' Contamination Data

All sand filled 2G pitches
Used for hockey, football etc.
Method development

- Quantifying contamination by sedimentation
- Comparison of surfaces
- Comparison of techniques

Rubber/sand infill (3G, cylinders)

2G = PP, 23 mm, tufted
3G = PE, 50 mm, tufted

Infiltration rate (mm h⁻¹)

Added contamination (% w/w)

2G (2EW)
3G (2EW + Rubber)
FIH Basic
FIH Standard
FIH Global

± LSD (0.05)
Effect on performance

Contamination and infiltration rate

Contamination and pitch drying

Infill contamination (%)

Infiltration rate (mm/h)

Days after wetting

Infill moisture content (%)
Applications (2)
Field operation effectiveness

- Compressed air renovation
  - Air blown into carpet to loosen pile and infill
  - Infill removed by brushing, cleaned and replaced

- Pressurised water renovation
  - High pressure water (17.2 MPa / 2500 psi) blown to loosen pile and infill
  - Infill removed by brushing and shovelling

17 mm pile: 9-2% (72% removal)
19 mm pile: 4.9-0.9 (83% removal)
11 mm pile: 18-2% (89% removal)
20 mm pile: 10-9% (13% removal)
Effect of infill quantity on performance

23 mm PP pile

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Effect of nap on performance

Effect of nap on ball roll

Ball deceleration (m/s²)

<table>
<thead>
<tr>
<th></th>
<th>With nap</th>
<th>Against nap</th>
<th>No nap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball deceleration (m/s²)</td>
<td>0.25</td>
<td>1.50</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Fibre wear
Virgin polypropylene fibre

Acc.V  Spot  Magn  Det  WD  Exp
5.00 kV  3.0  200x  SE  12.2  1

100 µm
After 28 days of abrasion by sand
Wear

Field conditions


<table>
<thead>
<tr>
<th>Acc.V</th>
<th>Spot</th>
<th>Magn</th>
<th>Det</th>
<th>WD</th>
<th>Exp</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.0 kV</td>
<td>3.0</td>
<td>200x</td>
<td>SE</td>
<td>13.7</td>
<td>1</td>
</tr>
</tbody>
</table>
Effect of sand

0 500 w/ sand 500 w/o sand

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Prevention

• Maintenance techniques need to:

  • Ensure even distribution of sufficient (not excess) infill

  • Minimise infill contamination

  • Make sure fibre is upright
Guidelines

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  www.cranfield.ac.uk/sas/sst
Guidelines
Outline

1. Prevention is better than cure
2. Right machinery, right contractor
3. Know your pitch
4. Schedule your work according to usage
5. Conduct ‘as and when’ maintenance too
6. Plan for replacement
1. Prevention better than cure

1. Plan for a 10:1 use:maintenance ratio
2. Select quality, durable carpets/constructors
3. Have a set of rules for users (and put them on a sign)
4. Plan for clean, dry access
5. Provide (and empty) litter bins
6. Get the right fences
7. Don’t have adjacent/overhanging trees
8. Build in equipment storage areas
9. Get the right machinery

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2. **Right machinery, right contractor**

- Don’t just buy on cost!
  - Consider effectiveness
  - Match working width to access but also work efficiency
  - Think flexibility / multi-tasking (but don’t compromise)
  - Limit the load on the pitch
- Secure safe storage, with dry access to the site is essential
A basic equipment list

• A 1 - 2 m drag brush
• A sweeping / surface litter collection device
• A leaf blower / collector as necessary
• A prime-mover (tractor/buggy) if necessary
• Drain cleaning equipment
3. Know your pitch

- Do a pitch audit (regularly)
Know your pile and infill

Measure pile heights and infill depths

Aim for a 2 mm difference

Monitor change

Measure infill contamination

Cranfield University Technology

Cranfield Infill Contamination Assessment Method

What you need:
- 3 x see-through cylinder/tube about 59 mm diameter
- minimum 300 mm long (cork in the supermarket - also used for posters etc)
- 1 x Calgon tablet (as in Washing Machines)
- 3 L of water
- 2 x drop of washing up liquid
- 300 g of infill
- 1 x bucket (> 3 L)

Taking the sample
You need to sample from across the pitch although if you have a particular problem area you should look at this separately and compare results with the rest of the pitch. Extracting the sample is difficult as you need to get all the infill out from right down to the bottoms of the pile without damaging the pile. Hair combs are useful for this - make sure you get it all up though - including the contamination. Scrape it into a bag and take it to your lab.

Method:
1. Mix the water, the Calgon, bicarbonate of soda and washing up liquid into a solution until it is all dissolved.
2. Add one third of the solution to each cylinder.
3. Add one third of the sample to each cylinder and stir well.
4. Allow to settle overnight.
5. Record the depth of contamination to the nearest millimetre.
6. Record the depth of infill from the nearest millimetre.

Calculating the Results:
1. Calculate the percentage contamination as follows for each replicate:

   \[
   \text{Contamination} = \frac{\text{Depth of Contamination}}{\text{Depth of Infill}} \times 100
   \]

2. Average the three results as follows:

   \[
   \text{Average Contamination} = \frac{\text{Contamination 1} + \text{Contamination 2} + \text{Contamination 3}}{3}
   \]

Your average result can then be used to monitor performance of your maintenance and to allow you to use it as a decision-making tool.

Health and Safety
Do not drink the solutions or mixtures. Wash your hands thoroughly and use suitable PPE. Dispose of all chemicals and wastes in accordance with best waste disposal practice.

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Table 1 Annual hours of use and maintenance calculator.

<table>
<thead>
<tr>
<th>Usage</th>
<th>Example Hours</th>
<th>Your Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal practice (including lessons in schools)</td>
<td>800</td>
<td>A</td>
</tr>
<tr>
<td>Internal match play</td>
<td>200</td>
<td>B</td>
</tr>
<tr>
<td>External practice / short form</td>
<td>600</td>
<td>C</td>
</tr>
<tr>
<td>External full match play</td>
<td>100</td>
<td>D</td>
</tr>
<tr>
<td>Recreational use / Other</td>
<td>50</td>
<td>E</td>
</tr>
<tr>
<td>Total hours of use</td>
<td>1,750</td>
<td>T</td>
</tr>
<tr>
<td>Maintenance hours</td>
<td>150</td>
<td>M</td>
</tr>
</tbody>
</table>
4. Schedule your work

+A typical schedule (for a pitch being used 2000 h/yr)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every 1-2 days</td>
<td>Empty bins</td>
</tr>
<tr>
<td></td>
<td>Sweep pitch*</td>
</tr>
<tr>
<td>Weekly</td>
<td>Drag brush</td>
</tr>
<tr>
<td></td>
<td>Inspect for damage</td>
</tr>
<tr>
<td>Every 2-4 months</td>
<td>Standard power Brush</td>
</tr>
<tr>
<td>Every 3-4 years</td>
<td>Deep power brush</td>
</tr>
<tr>
<td>Every 5-10 years</td>
<td>Infill jetting and replacement</td>
</tr>
</tbody>
</table>

+ maintain the drains – that’s what the rodding-eyes are for!

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5. As and when maintenance

- Seams and patches
- Chewing gum
- Moss and algae
- Line marking
- Fence repair
6. Replacement

• Plan for the cost of replacement and don’t raid the sinking fund.

• Good quality maintenance can prolong the period before replacement.

• Think about replacement at the time of design (sub-base / shock pad selection etc).
### Key summary points

1. Design your pitch to avoid maintenance problems
2. Plan to maintain from Day 1.
3. Keep to the 10:1 – usage : maintenance ratio
4. Keep infill levels topped up and prevent capping and poor playing quality
5. Keep infill clean so that through-pitch drainage works
6. Keep a regular eye on your pitch so that problems don’t get out of hand
7. Engage and inform your users on how they can look after their pitch
8. Have a go at the Pitch Condition and Maintenance Audit – how well are you doing?
So what about 3G?

- What is transferable?
  - Testing methods
  - Principles of the guidelines

- What is different?
  - Variety of fibres, infills, construction etc
  - Combing and aggression
  - Expectations
Thanks for listening

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