What is Capiphon?

Revolutionary Drainage Technology

Best Invention of the Year 1999

International Exhibition on Ideas, Inventions and Novelties
Nuremberg
What is Capiphon?

- 20 cm wide belt of soft durable plastic
- 2 mm thick
- \(\Omega\) (Greek Omega) shaped grooves on under-side
- 0.3 mm opening, 1 mm internal pore
What is Capiphon?

Ample inlet openings densely distributed to create laminar flow without disturbance of surrounding soil particles.
What is Capiphon?

Capillary Water Flow Passages

Ample inlet openings densely distributed to create laminar flow without disturbance of surrounding soil particles

Cross Section View
What’s in a Name?

- Capiphon = *capillary* + *siphon*
  - Capillarity
  - Siphon
  - Surface Tension
  - Gravity
How does it work?

Continuous column of water in soil
How does it work?

Capillary Action

Filtering Action

Siphon Action
What makes Capiphon better?

- Blockage Free
  - Gravity pulls larger particles down away
  - Smaller particles fall through or are flushed out

- Conventional systems flow rate decreases over time
What makes Capiphon better?

Blockage Free

Clogged Perforated Pipe
What makes Capiphon better?

Blockage Free

Clogged Perforated Pipe

Smart Drain Pipe Still Working!!!
What makes Capiphon better?

- Draws water in all directions
- 5 cm below belt in many soils
What makes Capiphon better?

- Flexible
  - Low fuss installation
  - Suitable for unstable soils
What is Capiphon?
What makes Capiphon better?

Compression Resistant & Resilient

– Carry heavy traffic immediately after installation
– Can be placed under massive structures
What makes Capiphon better?

Easy Handling & Storage

– Warehouse & On-site
– 100m Rolls in Stackable cartons (33kg)
– Simple roll out at installation
What makes Capiphon better?

Simple, Low Risk Installation

– No need to excavate to an accurate gradient level
– Fabric free
– Aggregate filter free
– Few fittings
What makes Capiphon better?

Potential for Mechanical Installation

– Significant cost & time benefits
– Minimal soil profile disturbance
– Minimal turf disturbance
– Retrofit sub-surface drainage.
What makes Capiphon better?

Trouble-Free, Long-Term Performance

– No mechanical parts
– Anti-clogging forces constantly active
– Resists root invasion
– Not affected by normal soil movement
– Chemically inert (grey water, leachates)
– Low Life-time Cost
Objectives

• Compare flow characteristics:
  Capiphon Belt vs Capiphon Pipe vs Drain Coil
  • In water
  • In soil
    – Flooding
    – Natural rainfall

• Case Study
Capiphon Pipe vs Belt

- Head loss proportional to pipe length
- High friction loss expected in 1mm pipe
- Capiphon pipe designed to pass water into pipe every 1 metre

- Hypothesis: Higher flow rate in pipe
Drainage in Free Water

- R² = 0.759
- R² = 0.7244
- R² = 0.8471

Flow Rate (L/Min)

- Drain Coil
- Capiphon Pipe
- Capiphon Belt

Head (mm)
Drainage in Free Water: At Low Head

Flow Rate (L/min) vs. Head (mm)

- Drain Coil
- Capiphon Pipe
- Capiphon Belt
Flow Characteristics in Soil

- **Soil Analysis:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>13 %</td>
</tr>
<tr>
<td>Silt</td>
<td>7.03 %</td>
</tr>
<tr>
<td>Fine Sand</td>
<td>37.59 %</td>
</tr>
<tr>
<td>Coarse Sand</td>
<td>42.38 %</td>
</tr>
</tbody>
</table>
Drainage in Soil: First Run (10 March)
Drainage in Soil: Second Run (2-April)

- Drain Coil
- Capiphon Pipe
- Capiphon Belt
- Head (mm)
- rainfall (mm/100)

Days
Flow Rate (L/HR)
Head (mm)
Third Run (13-April)

- Blue line: Capiphon Pipe
- Green line: Capiphon Belt
- Red line: Drain Coil
- Brown dashed line: Head

Flow Rate (L/Min) vs. Log(Min)

- Head (mm)
- Log(Min)
- Flow Rate (L/Min)
# Time for Flow Commencement (min:sec)

<table>
<thead>
<tr>
<th>DATE</th>
<th>CAPIPHON PIPE</th>
<th>CAPIPHON BELT</th>
<th>DRAIN COIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 March</td>
<td>3:00</td>
<td>5:15</td>
<td>20:30</td>
</tr>
<tr>
<td>8 March</td>
<td>5:15</td>
<td>7:00</td>
<td>20:45</td>
</tr>
<tr>
<td>2 April</td>
<td>2:45</td>
<td>7:50</td>
<td>51:15</td>
</tr>
<tr>
<td>13 April</td>
<td>3:00</td>
<td>9:55</td>
<td>61:45</td>
</tr>
</tbody>
</table>
Normal Rain Events

- **rainfall**
- **Drain Coil**
- **Capiphon Pipe**
- **Capiphon Belt**

### Normal Rain Events

**Flow Rate (L/min)**

- **Head (mm)**

**Days**

**Flow Rate (L/min)**

- **0.010**
- **0.008**
- **0.006**
- **0.004**
- **0.002**
- **0.000**
- **-0.002**

**Head (mm)**

- **295**
- **275**
- **255**
- **235**
- **215**
- **195**
- **175**
- **155**
- **135**
- **115**
- **95**
- **75**
- **55**
- **35**
- **15**
- **5**
- **-5**
- **-25**
- **-45**

**Days**

- **0**
- **2**
- **4**
- **6**
- **8**
- **10**
- **12**
- **14**
- **16**
- **18**
- **20**
Volume Drained Over 47 Days  
(L/m²)

<table>
<thead>
<tr>
<th>CAPIPHON PIPE</th>
<th>CAPIPHON BELT</th>
<th>DRAIN COIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.8</td>
<td>27.6</td>
<td>7.4</td>
</tr>
</tbody>
</table>
Capiphon Pipe

Flow Rate (L/Min) vs Head (mm)

First Run
Second Run
Third Run
Fourth Run
April 2012
2 Hours after 43 mm downpour
Playground Soft-fall Drainage

Flow Rate (L/Hr) vs Days

Rain (mm) vs Days
Conclusions

• Capiphon performs better in soil
  – Commences flow sooner
  – Flows longer
  – Greater volume drained

• Drain Coil ceases to flow at 20 mm head
• Capiphon continues to flow to at least -45 mm
Conclusions

• Capiphon ideal for:
  – Playing fields
  – Race tracks
  – Under buildings, roads
  – Retaining walls
  – Rooftop gardens
  – Bioretention swales
  – Mining waste
  – Biomass
  – Etc, etc
Case Study 2
Race Track Renovation

• Problem:
  – 2 metre dip along back straight
  – High % fines in soil
  – Turf sodden & poor growth
  – Drain Coil dry with silt and roots

• Solution:
  – 8 cm wide trench, 350 mm deep, 2% slope
  – 150 mm fine gravel, 200 mm coarse sand
  – Run to Drain Coil trench alongside track
Capiphon Trial

- 10 mm coarse sand
- 50 mm belt
- Gravel & sand as before
- Run belt into Capiphon pipe