Q&A GreenFill:

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Purchase & installation

1. *What is GreenFill?*
   GreenFill is a bio-degradable polymeric granulate specifically designed for the use as a performance infill for sports pitches.

2. *What is the source material and where is it produced?*
   GreenFill is composed of biodegradable polyesters. The product is produced by the Dutch company Senbis at different production sites in the European Union.

3. *What makes GreenFill bio-degradable?*
   GreenFill is due to its innovative molecular structure receptive to microbiological (bacteria's and fungi) degradation. Basically, these small organisms eat the infill, after which only water, CO2 and humus remains.

4. *Under which circumstances will GreenFill degrade?*
   GreenFill will biodegrade in soil and in composting facilities. The biodegradation speed depends on elements like type of environment, moisture and temperature. As an example, there is much more biological activity in a compost heap then in normal soil conditions, there fore biodegradation is faster during composting.

5. *Is GreenFill already certified for biodegradation? (*)*
   Yes, this was carried out by the independent and specialized testing institute OWS in Belgium. The GreenFill is composed of biopolymers which are all certified by TüV with the OK Home Compost certificate. This means that the biopolymers are tested for disintegration, biodegradation, heavy metals and ecotoxicology (the impact on plant growth) according to current standards. The GreenFill pellet itself has been fully tested according to ISO17556 for biodegradation in soil. This standard prescribes a measured biodegradation of at least 90% within 24 months (2 years), compared to cellulose as reference material. The GreenFill shows about 95% biodegradation within 210 days (7 months), which amply meets the standard and certification requirements of the TüV.

6. *Is GreenFill a clean and safe infill to be used in contact sports? (*)*
   The GreenFill was extensively tested in independent laboratories on (eco)toxicology. No PAH's or hazardous substances according to the REACH regulations were detected in GreenFill. Also testing according to DIN EN 71-3 was done which showed no detection for any of the listed components. A full list of test results is available for interested customers. These test results lead to a confident conclusion that the infill is fully clean and safe to use as a performance infill in artificial turf.

7. *Why is GreenFill black?*
   Durability of performance infill is also affected by UV radiation from the sun. A black colour is a natural way to shed materials from UV degradation.

8. *What is the GreenFill bulk density?*
   The typical bulk density of GreenFill is 0.35g/cm3. Although this is lighter than water, after compaction of the material on the field and due to its oval shape the granule remains neatly in place in the artificial grass matrix.

9. *What is the typical composition of a sports technical layer in combination with GreenFill?*
   The sports technical layer of a GreenFill construction normally consists of a shock pad, artificial turf, stabilization sand and GreenFill. It is up to the respective manufacturer to decide which type of

shockpad, artificial grass (fibre length and shape, tuft density, etc.) and stabilization sand to use. In principle, there are no specific requirements concerning the turf, because the oval shape of the GreenFill grain ensures stability. The regular scattering height of GreenFill in a construction with a shockpad is 10 mm.

10. *How much GreenFill should be applied?*
Depending on the design of the synthetic turf system, typically 3 to 3.5 kg is applied per m2.

11. *What is the price of GreenFill and how is the availability*
GreenFill is positioned in the higher segment of performance infills. An artificial grass system with GreenFill is in the price range of TPE pitches. The availability of GreenFill is good, because the raw materials are sufficiently available and the production process is carried out on an industrial scale.

12. *Is GreenFill fully certified for use as a performance infill?*
Yes, GreenFill complies with the applicable international standards as an infill material for artificial grass football pitches. Furthermore, various synthetic turf suppliers have certified systems according to **FIFA Quality PRO**, **EN** and **Nordic** standards.

13. *What is the lifespan of GreenFill?*
GreenFill is expected to last as long as the artificial grass itself. The first pilot field with GreenFill was installed in September 2019. For two years the material was evaluated. The polymeric infill did not show any biodegradation signs and the performance was still very good. As with other artificial grass constructions and infills, it is important to keep the field clean. Organic material, such as leaves, algae and moss, should not remain on the field for long as it could trigger local biodegradation.

14. *Where have GreenFill soccer pitches been installed so far?*
Since 2019, several fields with GreenFill have been installed in the Netherlands. See our website www.iksportgroen.nl for an up-to-date overview.

Use & maintenance

15. *Does GreenFill lead to microplastics problems around the field?*
No. The GreenFill can fully biodegrade in soil. There will be no plastic parts remaining after this biodegradation is completed.

16. *Won't the result of degradation of GreenFill be nano-plastics?*
No. GreenFill will indeed first break down in smaller pieces, called disintegration, but this will only accelerate the actual biodegradation as the contact surface grows. Eventually GreenFill will fully biodegrade into natural components like water, carbon-di-oxide and humus.

17. *Is GreenFill a microplastic in the definition of ECHA?*
The European Chemical Agency ECHA proposes an EU wide ban on intentionally added microplastics, which specifically also targets infills used in artificial grass. ECHA makes an exception for polymeric products that are biodegradable in soil in accordance with ISO17556. Bio-degradation under industrial composting, as such is the case for PLA, are still being considered a micro-plastic in the ECHA proposal. There is an on-going discussion whether or not bio-degradation in sea water is also required for an exemption of the ECHA microplastic definition. This doesn't seem to be very relevant for infill but the ECHA restrictions are also designed to ban the use of plastics in other product applicatons. GreenFill will probably degrade faster in water than conventional polymeric infills, but it will not comply with the norms for marine degradation that requires full degradation in water within 6 months.

18. *Will GreenFill not degrade on the pitch?*
    The bacterial activity on artificial turf pitches is very low compared to soil or in a composting installation. Therefore the disintegration and biodegradation is barely taking place on the pitch itself.

19. *Is GreenFill sensitive to water or heat?*
    Performance tests have indicated that GreenFill is not sensitive to hot air (70 °C) or cold water. Long term boiling water can damage the infill, but that is not considered a realistic simulation of the weather condition faced when used in artificial grass. The presence of moisture and high temperature can increase microbiological activity which may increase biodegradation speed. However, on the pitch itself this will only have minor effect due to the relative low presence of bacteria's and fungi.

20. *How is the abrasion resistance of GreenFill and can GreenFill pitches be used during winter conditions?*
    Tests in independent laboratories have shown that GreenFill is a true performance infill with excellent abrasion resistance, which is 98% according to the test method ISO5075. Also tests with the LisportXL wear machine show excellent results. This is in line with other performance infills like TPE. Furthermore, GreenFill pitches can be used during winter conditions just like other pitches with polymeric infill.

21. *Is there any chance of moss and algae growth on GreenFill fields?*
    The chance of moss and algae growth on GreenFill fields is no different than with other polymeric infills. Obviously it's important to maintain the pitches regularly to limit moss and algae growth as much as possible. Otherwise the GreenFill-granules could be damaged in the long run.

22. *What maintenance scheme is advised and how much GreenFill needs to be re-filled annually?*
    The maintenance frequency of GreenFill pitches is comparable to other polymeric infills. The loss of infill is of course strongly dependent on the type of synthetic turf system, the playing intensity, maintenance and measures to prevent the spread of infill. After more than a year of intensive play, there has been no need for re-filling the pitches installed so far.

End-of-life

23. *What are the end-of-life options for GreenFill?*
    At the end of their functional lifespan, GreenFill-granules can be reprocessed or composted. This means that there is no concern for waste and related costs for the pitch owner. If GreenFill-granules still provide sufficient technical performance at the time of field replacement, re-use is also an option. At the end-of-life of a pitch, the options of reuse and reprocessing will have to be assessed on a situational basis. In any case, the option to compost the GreenFill-granules after functional life is always a sustainable solution.

24. *Who is responsible for the disposal and possible reprocessing or re-use of GreenFill?*
    The field owner and the contractor will have to make mutual agreements about this. The advantage of GreenFill is that it is thermoplastic and therefore can easily be melted again for a higher-quality purpose of recycling. This is not an option for vulcanized rubber such as SBR. Obviously, Senbis is available to support you during the consideration process about reprocessing.

25. *Where and how should the GreenFill-granules be removed from the artificial turf and how can it be separated from the infill-sand?*
    The process of removing GreenFill from the artificial turf and separating it from the infill-sand will be the same as for other (polymeric) infill materials.

(*) See Senbis statement regarding 'Safety, (eco)toxicology and environmental tests on GreenFill'