

# Statement of Verification



EU Environmental Technology  
Verification pilot programme



<b>Technology:</b>	Re-Match Artificial Turf Recycling
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Signed,

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This Statement of Verification summarises the main results from the verification of Re-Match.

The verification was performed under the EU Environmental Technology Verification (ETV) Pilot Programme. The EU ETV Pilot Programme was established to help innovative environmental technologies reach the market by providing a framework for independent evaluation of the performance of such technologies.

This verification was undertaken by the Danish verification body, ETA-Danmark A/S. ETA-Danmark is accredited by the Danish Accreditation Body, DANAK, according to EN 17020 for performing environmental technology verifications. This Statement of Verification is available on the website of the EU ETV Pilot Programme: <http://iet.jrc.ec.europa.eu/etv/verified-technologies>

## 1. Technology description

The process is developed to treat artificial turfs to recycle the materials. Turfs are constructed of a backing (bottom layer) to which the plastic grass fibres are attached. When placed in a football field a mixture of sand and rubber granulate is typically added. After end of use these materials are returned in a rolled mat for recycling.

The principle of the process is shown in Figure 1. The first step is the pre-shredding of the mats of artificial turfs. After pre-shredding, many mechanical treatment steps follow where sand and rubber granulate is separated from the backing. The backing is further downsized to liberate the grass fibres. The separation machinery used includes sieves, wind sieves and separation tables. No chemicals or water are used in the cleaning process.

The process is constructed as a continuous process where worn-out artificial turfs are fed into the inlet to the plant (the pre-shredder), and a number of outputs are produced continuously from mechanical sorting of the material from the pre-shredder. The construction of the plant is proprietary but known to the verification and test bodies at Danish Technological Institute.

The typical capacity of the plant is 3-6 tons of artificial turf per hour depending on the composition of the artificial turf.

The 4 main products, which are collected for recycling from the plant, are:

- Sand
- Rubber granulate
- Backing material
- Grass fibres

Below a sketch is shown of an artificial turf with infill of sand and rubber granulate and the products produced by the Re-Match artificial turf technology.

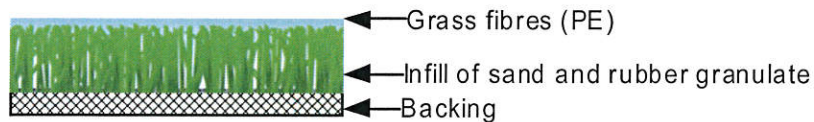


Figure 1: Construction of artificial turf.

There are several different types of artificial turf. The turf, which is typically treated by Re-Match, either has SBR rubber or TPE rubber as rubber granulate.



Figure 2: Products (sand, rubber granulate, backing, grass fibres (polyethylene)).

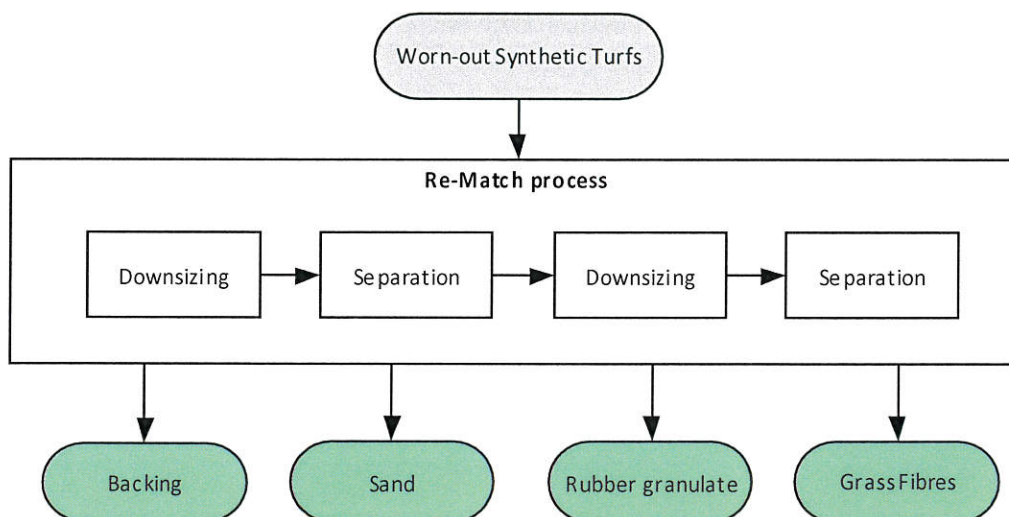


Figure 1 Principle of the Re-Match process, showing inputs and outputs.

## 2. Application

### 2.1. Matrix

The matrix is worn-out artificial turf.

The Re-Match process is verified as a mechanical treatment of worn-out artificial turf of the following type: Typical artificial turf with content of added sand and rubber granulate.

In the test programme, 3 separate tests were performed on typical used artificial turfs.

In test 1, used artificial turfs with TPE rubber infill and sand were used, and in test 2 and 3 artificial turf with SBR rubber infill and sand was used.

### 2.2. Purpose

The purposes of the Re-Match artificial turf recycling process is to process worn-out artificial turf in 4 output fractions that can be recycled.

Additional parameters include:

- Moisture content of added worn-out turf material
- Calculated composition of artificial turf

The effects of this application are

- High recovery of output fractions
- High purity of the output fractions sand, rubber granulate and grass fibres
- Low energy consumption per ton recycled waste

### 2.3. Conditions of operation and use

The Rematch process was tested and verified under normal conditions of operation similar to typical plant operation.

### 2.4. Verification parameters definition summary

Performance parameters are defined by taking, e.g., regulatory requirements, application-based needs, and state-of-the-art performances into account.

In Table 1, the performance parameters for this specific verification are presented. The figures mentioned in the column *Value* refer to the performance claims of the proposer.

Table 1: Parameter definition table

Parameter	Value (performance claim)
Recovery of sand %	>=95% of TS
Recovery of rubber granulate %	>=90% of TS
Recovery of plastic grass fibres %	>=85% of TS
Recovery of backing %	>=75% of TS
Purity of sand % (fraction A 0.2-0.8 mm)	>=95% of TS
Purity of sand % (fraction B 0.2-0.8 mm)	>=95% of TS
Purity of rubber granulate %	>=99% of TS
Purity of plastic grass fibres %	>=85% of TS
Purity of backing %	>=75 % of TS
Total Energy consumption kWh/ton treated turf	<250

### 3. Test and analysis design

#### 3.1. Existing and new data

No existing data has been used in the present verification.

#### 3.2. Laboratory or field conditions

The tests were performed on the Re-Match full-scale plant positioned in HI-Park 415, DK 7400, Herning. Samples were analysed in the Laboratory at Danish Technological Institute

#### 3.3. Matrix compositions

The Re-Match artificial turf recycling process is verified on typical used artificial turfs with the analysed composition of sand, rubber granulate, backing material and grass fibres listed under additional parameters in section 4.4.

#### 3.4. Test and analysis parameters

The test is based on adapted procedures for analysing purity and recovery as described in the test plan/test report.

#### 3.5. Tests and analysis methods summary

Three test runs of the Re-Match artificial turf recycling process were performed. In test 1, used artificial turf with TPE rubber infill and sand was used, and in test 2 and test 3 artificial turf with SBR rubber infill and sand were used.

All outputs from each test were collected and weighed. 3 subsamples were taken from the produced outputs during each test period and combined to representative samples. The processed amount for each test was between 56 and 75 tons of material based on output weight. The samples from the tests were analysed in the laboratories at Danish Technological Institute. Furthermore, the electricity and gas consumption was measured for each test run.

### 3.6. Parameters measured

In addition to the parameters in section 2.4, the electrical consumption and gas consumption were measured as well as the moisture content of the samples of the added artificial turf material.

## 4. Verification results

### 4.1. Performance parameters

In Table 2, the verified performance is presented as a mean value together with standard deviations.

Table 2: Verified performance parameters for purity of products and recovery of organic waste.

Parameter	Test run 1	Test run 2	Test run 3	Average	Standard deviation
Recovery of sand %	92.9	95.5	98.5	95.7	2.8
Recovery of rubber granulate %	93.1	82.8	91.0	89.0	5.4
Recovery of plastic grass fibres %	85.4	78.8	91.5	85.1	6.1
Recovery of backing %	89.9	91.7	91.5	91.0	1.0
Purity of sand % (fraction A 0.2-0.8 mm)	98.5	99.2	99.3	99.0	0.4
Purity of sand % (fraction B 0.2-0.8 mm)	99.5	99.6	99.6	99.6	0.1
Purity of rubber granulate %	99.995	99.972	99.971	99.979	0.014
Purity of plastic grass fibres %	82.8	73.5	89.0	81.8	7.8
Purity of backing %	81.9	74.9	74.1	77.0	4.3
Electricity consumption kWh/ton treated turf	14.9	8.6	9.7	11.0	2.7
Gas consumption kWh/ton treated turf	115.7	71.9	95.6	94.4	19.5
Total energy consumption kWh/ton treated turf	130.5	80.6	105.3	105.4	22.2

### 4.2. Operational parameters

The operational parameters are shown in the table below.

Table 3: Operational parameters.

Parameter	Test run 1	Test run 2	Test run 3	Average	Standard deviation
Capacity ton/hour	3.7	6.3	5.2	5.1	1.1

### 4.3. Environmental parameters

The relevant environmental parameters are included as performance and operational parameters.

#### 4.4. Additional parameters

The moisture content of the added artificial turf was measured for each test, and the composition was calculated from the analysis and amounts of all output fractions.

The results are shown in the tables below:

Table 4: Moisture content of incoming artificial turf.

Test	Moisture (weight%)
Test 1	2.8
Test 2	4.3
Test 3	12.3
Average	6.4
Standard deviation	5.1

Table 5: Composition of artificial turfs (dry matter-based).

Test	Sand (weight %)	Rubber (weight %)	Backing (weight %)	Fibre (weight %)
Test 1	40.7	47.3	3.7	8.2
Test 2	73.4	18.3	3.4	5.0
Test 3	67.6	24.8	2.7	4.7

The rubber granulates in the artificial turf in test 1 was based on TPE rubber, and in test 2 and test 3 the artificial turf was based on SBR rubber.

#### 5. Additional information

Additional information can be found in the verification report.

#### 6. Quality assurance and deviations

The test and verification activities were planned and undertaken to satisfy the requirements to quality assurance described in the General Verification Protocol developed for the EU ETV Pilot Programme.

The test activities were undertaken by the DTI Test Centre (test body). DTI has a quality management system covering ETV test activities that follows the principles of EN ISO 9001. It is assessed that the quality management system fulfils the requirements of the General Verification Protocol (Chapter C.III), and that the DTI Test Centre is qualified to participate in the EU ETV verification process.

An external review was performed for the specific verification protocol and the verification report. The external review was carried out by Anke Oberender.