

Recycling Manual

Grower



Part of the ROCKWOOL Group

Content

P5

1 Introduction

P8

2 Preparation of used substrate
for the recycling process

P12

3 Characteristics and safety of the
used substrates

P14

4 Storage and transportation

P17

5 Recycling partners

P19

6 Legislation

P20

7 Appendices



**Achieve
sustainable
food production
for future
generations**

1 Introduction

After a season of productive vegetable growing the growing media consist of useful raw materials for next life applications. Therefore, a recycling process is beneficial for the parties involved and growers play an important role in the successful recovery of these raw materials. That's why we created this document, to provide growers using Grodan growing media with best practices and relevant information to organise the handling, recycling and disposal of used Grodan substrate.



Figure 1 Involved parties in sustainable recycling process of used Grodan substrate

* Reusable Substrate Granulate (RSG)



What are the benefits of organising a sustainable EOL for Grodan substrate?

Careful management of Grodan EOL (end-of-life) substrate will strengthen your business, surroundings and society in general, both in the short and long term. It will help you to:

- recycle more economically than the use of landfill
- protect the environment
- contribute to environment by increasing the reuse of materials instead of creating waste
- reduce the amount of waste: less valuable resource losses (fertilizer, water), reduced logistics
- improve your sustainability profile: consumers increasingly prefer sustainable products.

During EOL processing, the used Grodan substrates will be segregated into four recycling fractions:

- plastic waste
- the remains of plants
- residual drainage water
- Reusable Substrate Granulate (RSG).

All waste fractions will be recycled or reused responsibly (Figure 2).

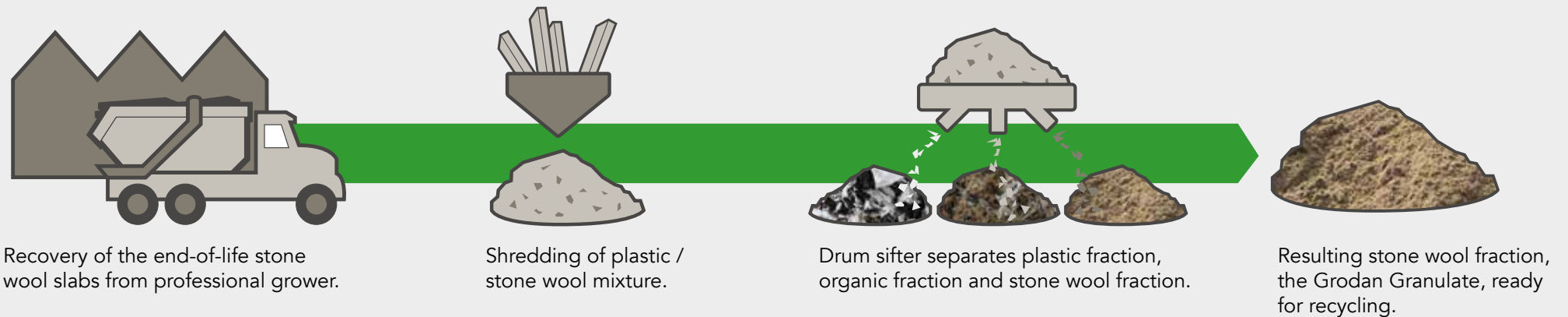


Figure 2 End-of-life processing of used Grodan substrate resulting in four valuable recycling fractions

Potential applications for RSG materials

The shredded substrate slabs, blocks and plugs are recycled into raw materials in a low-energy process. Reusable Substrate Granulate (RSG) is proven to be beneficial for various manufacturing processes such

as the production of bricks, compost, substrate mixes or soil improvers production (Picture 1). In some cases this raw material is reused in ROCKWOOL factories to create new stone wool products.



Picture 1 Applications for RSG materials



How to use this manual?

It is beneficial to pay attention to proper 'Next Life Management' of Grodan EOL substrate. In this manual, we focus on the actions of the professional grower to achieve a sustainable recycling process. In addition we would like to give insights how these actions impact the recycling chain, the environment and society. In this manual we focus on:

- preparation of the used substrate for the recycling process
- characteristics and safety of the used substrate
- storage and transportation
- recycling partners
- legislation

For specific and detailed information related to your circumstances, please feel free to contact us.

2 Preparation of used substrate for the recycling process

In Figure 3 the various 'life' phases of the substrate are explained. After the growing season the used substrate are made available for the recycler.

Optimization of the recycling process starts already during the cropping period. Proper crop management in the 6th phase of the Grodan 6-PHASE model enables a decrease of total recycling costs and increases the quality of reusable substrate granulate (RSG). In this phase water content is reduced as root activity decreases because of the crop's declining performance, but still enables steering of the remaining substrate water content. With low water content in the substrate at the end of the cropping period, only a minimal amount of valuable nutrients will be lost. A low water content also results in optimisation of transport costs.

3 kilograms

Weight of a slab (100x20x7.5cm) with ideal water content

For recycling purposes the water content of the substrate slabs is most optimal at approximately 20% (v/v, measured with GroSens Multisensor) before cutting-off the crops (maximum crop stem is 3 centimeter). A slab with dimensions 100x20x7.5cm with ideal water content weighs approximately 3 kilograms.



Why is the water content of the used substrate important?

Too low water content in used substrate will result in:

- **dust formation** during handling in the recycling process. A minimal moisture content of 15% (w/w) is advised to prevent this
- less breakdown of the substrate structure resulting in a **lower density** of the used substrate. The lower the density, the lower the volume, the lower the costs of transportation.

Too high water content in used substrate will result in:

- a higher residual water fraction. As water treatment is expensive, the total recycling costs will increase. It is better to reuse the water (containing useful components) in the greenhouse
- a higher risk of **uncontrolled water leachate** emissions into the environment as, during storage and transportation, leachate may be lost.

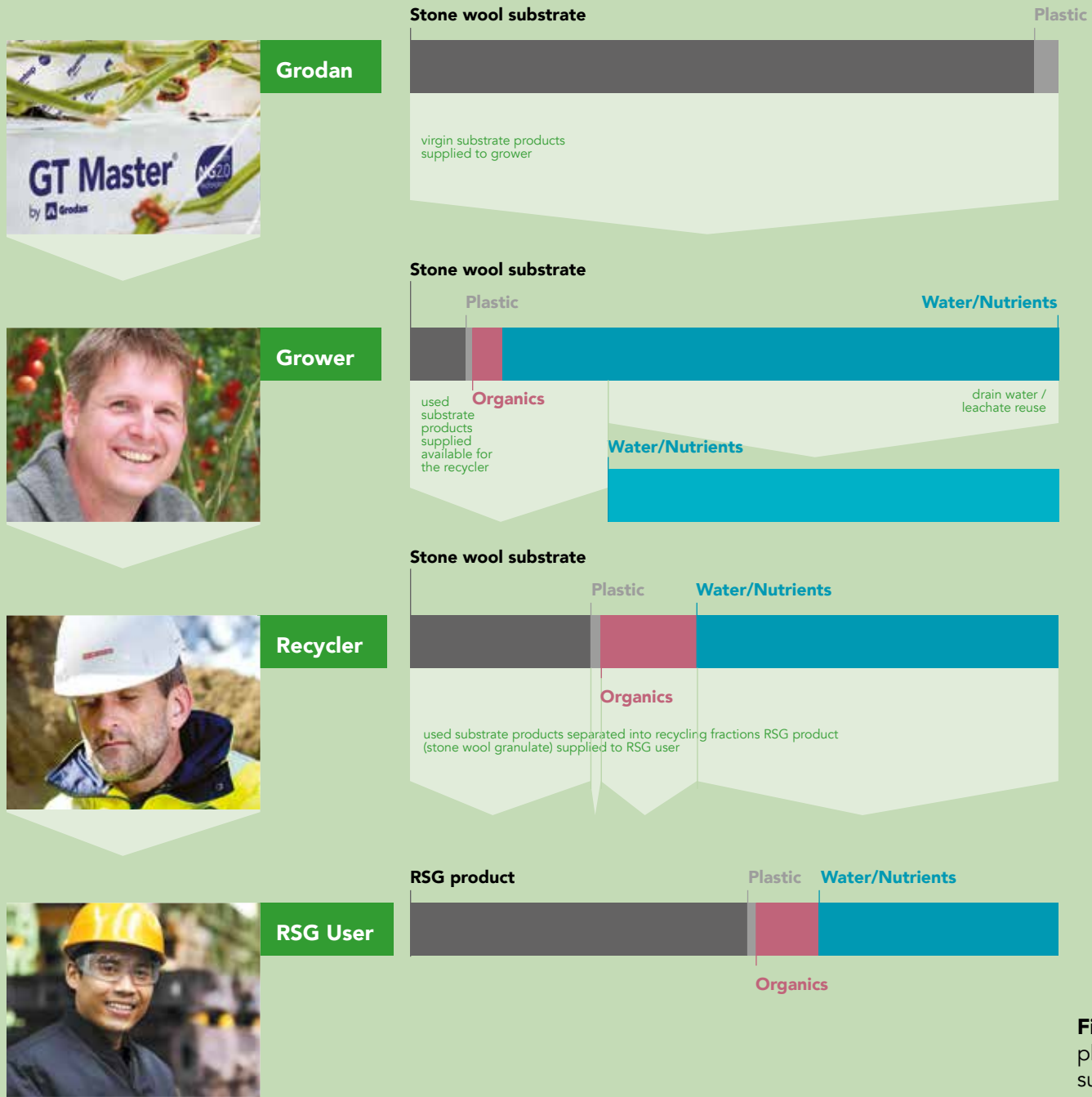


Figure 3 Product life phases of Grodan substrate products

The composition and quality of the used substrate available to a recycling partner is crucial to ensure an efficient recycling process. (see Picture 2).

It is therefore important to:

- Remove clips, ropes, pest control cards, and drippers. Failure to remove these components will result in increased cost or rejection by recyclers
- Limit the amount of nutrients, crop protection chemicals and other chemicals (like cleaning

and disinfection materials) in the substrate.

These types of components cannot be removed in recycling processes and might lead to rejection of the material.

Any additional costs which are incurred by a recycler as a result of removing contaminants or disposing of rejected loads, will be transferred to the grower.



Picture 2 Examples of potential contaminants in Grodan used substrate



What more can I do to improve the RSG quality?

The procedure as described above involves minimal handling for the grower, and outsourcing of all recycling activities to external recycling partners. Used substrate with and without plastic wrapping can be stored or transported to (local) recycling partners for further processing and separation of the components. Cost savings on the total recycling process can be achieved by doing some extra work before further processing by the recycling partner.

For example granulation (size reduction) of used substrate without plastic wrapping will result in plastic-free RSG that can be directly delivered to RSG users.

It is possible to follow some alternative procedures (see Figure 4) to reduce costs, depending on the availability and cost of handling and equipment (see Picture 3):

- The removal of plastic wrapping from the substrate slabs and blocks, while still in the greenhouse. This facilitates water removal, composting process, and easy component separation in the recycling process at the recycling partners
- Size reduction can be performed by chippers typically used for plant shredding blades should be adapted for abrasive material. This has the advantage of 65% volume reduction
- Volume reduction can be achieved by using press containers and or balers.

Tip

It is advised to have plastic wrappings removed before using volume reduction equipment, as the plastic bags have a strong resistance and recyclers will have more problems separating the plastic afterwards.

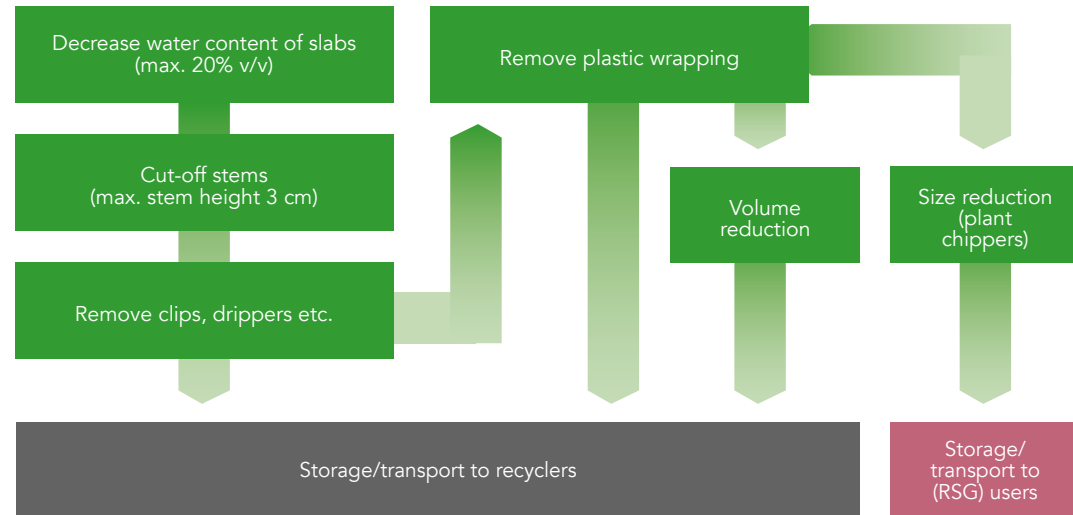


Figure 4 Possible greenhouse procedures for preparation of used Grodan substrate



Picture 3 Examples of plant removal (left), slab removal (mid), plastic removal from slabs (right) in greenhouse



Picture 4 Example of baler (left), baled slabs without plastic (mid), and press container (right)

3 Characteristics and safety of the used substrates

Approximately 52m³ of EOL substrate will become available from each hectare of greenhouse area. This used substrate material can be considered as virgin material containing nutrient solution and organic material mainly from plant roots. The composition of the nutrient solution is dependent on the growers' recipes and the end of growing season procedure. An idea of the estimated composition and characteristics of the Grodan substrate and the separated fractions in the various phases can be found in Figure 5.

The characteristics and composition of the used substrate are shown in Table 1. In this table the effect of water content on the used substrate density can also be seen. Please note that the water content may vary depending on the procedure applied at the end of the crop.

Safety

Virgin and used Grodan stone wool products consist of mineral fibres, which are engineered to be safe for human beings, plants, and the environment. Since the introduction of the high-alumina low-silica fibre product range in 1997, ROCKWOOL stone wool production complies with the latest health and safety standards.

More information about safety of virgin and used stone wool substrate products can be found in Appendix 1.

Characteristics per ha	"dry material"		"wet material"	
Volume (m ³)	51,7		46,0	
Weight (tons)	15,2		27,7	
Density (kg/m ³)	294		602	

Composition	tons	% (m/m)	tons	% (m/m)
stone wool	4,2	27,6	4,2	15,2
DPE plastic film	0,25	1,6	0,25	0,9
organics (roots/stems)	2,23	14,6	2,2	8,0
water/fertilizer	8,55	56,3	21,0	75,9

Table 1 Composition of used substrate material

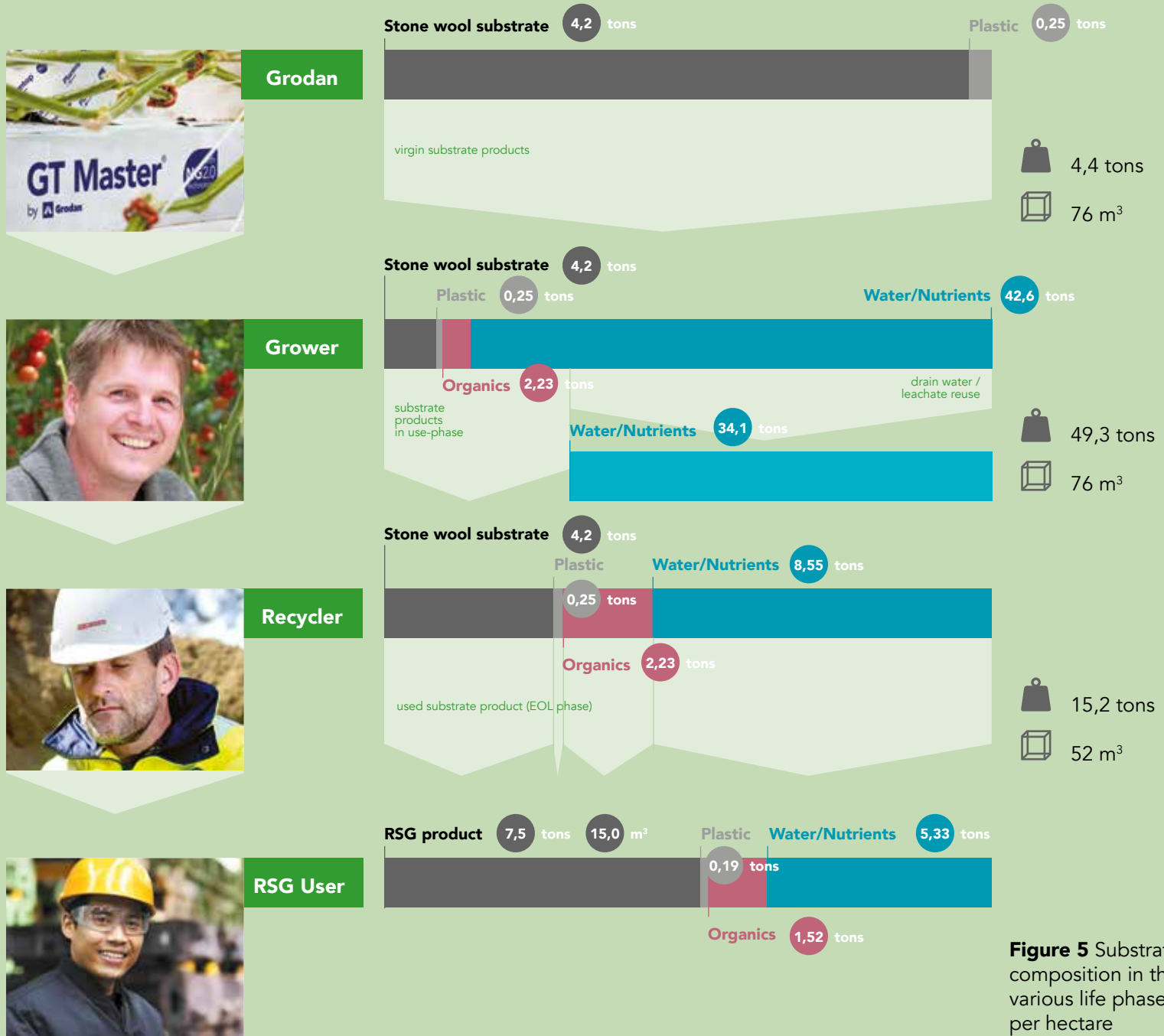


Figure 5 Substrate composition in the various life phases per hectare

4 Storage and transportation

Used substrate should preferably be transported directly to a selected recycling partner. Alternatively you may choose to temporarily store it at your property. In both cases attention should be paid to prevent emissions to the environment (drain water, dust, and plastics).

Used substrate material should either be stored on a solid base or in bins capable to facilitate the collection, treatment and reuse of drain water leaching from the substrate (see the Grodan brochure *'Best Practice Guidelines for Greenhouse Water Management'* and Picture 5). The composition of the drain water leaching from used substrate is dependent on the nutrient composition used by the grower.

Another reason to store on a solid base is to prevent substrate contamination with soil, stones, etc. while loading, which may lead to equipment damage during recycling processes.

The used substrate should preferably be covered to prevent dust emission in case the material becomes too dry. Weed control chemicals should not be applied since this renders the used substrate unusable for most next life applications.



Picture 5 Examples of storage bin (left), solid base storage (mid), and drain water collection (right)

A local hauler could be contacted for transportation of used substrate to the recycling partner. In addition, it may also be possible that the recycler offers transportation services and in some cases transportation might also be carried out by the grower himself. In any case, the means of transportation (and therefore the costs) will vary depending on the distance to the depot or recycling facility.

Up to 100 km we advise the use of bins or containers. Up to 500 km we advise the use of walking floor trucks. For longer distances, other possibilities such as boat or train could be investigated.



What is the effect of water content on loading capacity and transport costs?

The water content will have consequences for loading capacity and transport costs.

If the used substrate is **too dry**:

- The weight per load will be very low and the load volume will be limited since the used substrate is light and will not compress under its own weight
- A solution for this situation is to use compression equipment (e.g. press containers, balers).

If the used substrate is **too wet**:

- The truck can be easily overloaded
- The load volumes per truck will be limited
- This results in higher transport cost.

Legal compliance transportation

If the transportation of used substrates is to be handled by the grower themselves, please check beforehand about the status of such shipments according to local waste laws.



How do I select the right logistics partner for transportation of the used substrate material?

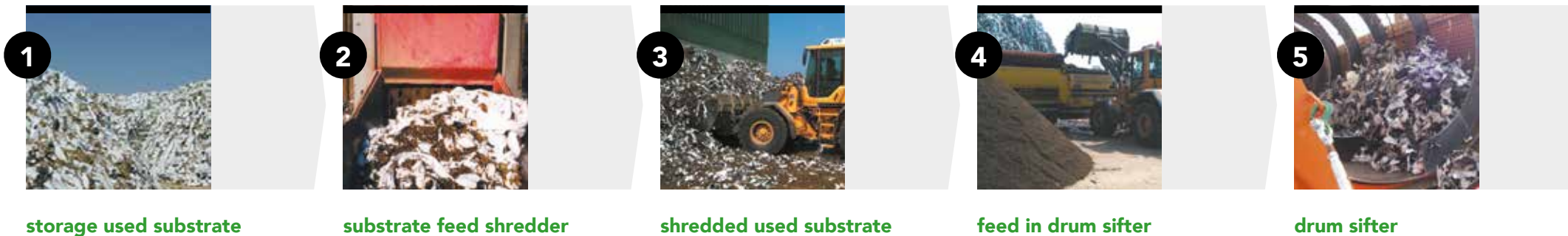
To find a suitable logistics partner for the transportation of used substrate material it is advised to use the following guidelines:

- ✓ Available collection capacity in peak season
- ✓ Suitable transport permits, especially in case of waste transport.
- ✓ Availability of water tight containers to prevent leakage during transport (see Picture 6).
- ✓ Availability of loading devices higher than 4 m, as walking floor trailers are very high.
- ✓ Availability of an existing logistic network in the target area.



Picture 6 Examples of 40 m³ bins (left) and walking floors (right)

Figure 6 Processing steps and equipment generally used for the used substrate recycling process at recycler



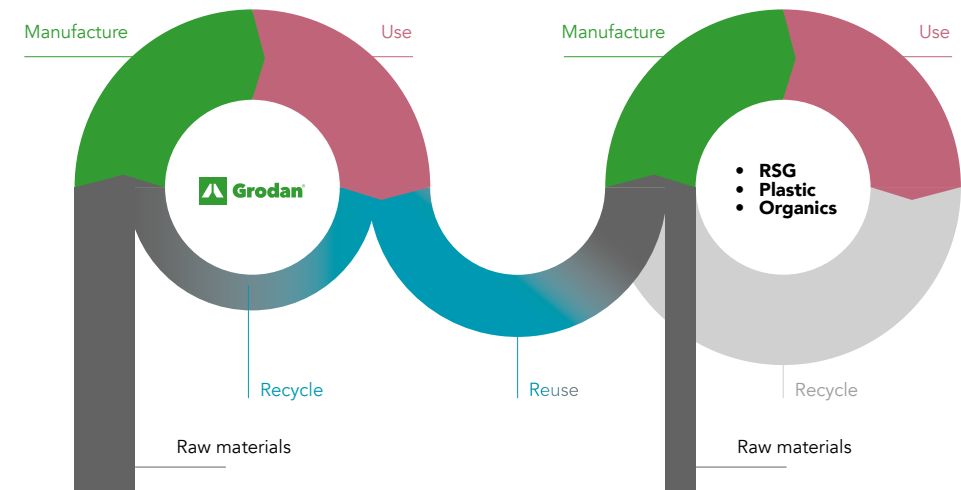
5 Recycling partners

We continuously initiate, facilitate and manage recycling initiatives worldwide. Especially in Europe we gained a lot of knowledge and experience in reuse, recycling and upcycling of used stone wool products. R&D, continuous improvement and eco-design will offer the opportunity to extend the range of stone wool recycling loops in the future.

For successful implementation of Grodan substrate recycling loops it is essential to identify the right partners and to ensure close cooperation between them.

Depending on the RSG application a choice should be made to ensure the equipment can produce the required quality of RSG. An example of processing steps and equipment generally used for the used substrate recycling process at the recycler can be seen in Figure 6.

It is easier and more efficient to have logistics and recycling handled by one partner.



plastic fraction



RSG fraction

1. slabs are fed into shredding machine to rip apart the plastic and stone wool. Slow shredding is preferred to ensure large pieces of plastic which will be easier to separate from the mixture
2. the mixture of shredded plastic and stone wool is taken from the shredding machine
3. the mixture of shredded plastic and stone wool is dropped into a drum sifter
4. the mixture rotates around the drum and the stone wool fraction falls through the sieves
5. the plastic is conveyed out of the drum sifter and taken for use in energy generation systems or for recycling, depending on market opportunities
6. the RSG fraction is almost 100% clean of plastic and can be supplied to brick factories, compost or substrate manufacturers, used as soil improver, or used for recycling in a ROCKWOOL factory depending on local circumstances.



How do I select the right recycling partner

When looking for a suitable recycling partner to process used substrate material it is recommended to use the following checklist:

- ✓ Partners should be experienced in the in resizing and separation of waste streams e.g.
 - green waste chipping
 - compost production
 - wood chipping
 - demolition waste treatment
 - potting mix production.

- ✓ Make sure your chosen partner has sufficient storage space for both the used substrate as well as RSG

- ✓ Remember that for each 40 ha grower an RSG storage capacity of 800 m³ will be required (= for example 15m*15m*3,5m) until all RSG has been reused by outlets.



**Grodan makes
our world a
bit more
sustainable –
every day!**

6 Legislation

In general used materials from greenhouses are considered as waste. This includes substrate discarded after their primary use. In all cases local waste legislation is applicable which will vary per country. Continuous monitoring is required to track the development of local waste legislation.

In the past, extensive legal checks have been done in the EU, Canada and US, which confirm that Grodan used substrate is considered to be non-hazardous waste, with reuse potential in several applications.

The used substrate is also suitable for standard landfill in the same way as household waste should this be legally applicable.

7 Appendices

Appendix 1 Safety of new and used stone wool substrate products

New and used Grodan stone wool products consist of mineral fibres which are engineered to be safe for human beings, plants and the environment. These stone wool fibres fully comply with the latest Health & Safety standards.

- The mineral fibres are engineered to have a very low biopersistence in the human body and as result are classified as non-carcinogenic according to the European Commission Directive 2001/59/EC.
- The mineral fibres are not skin-irritant and are therefore safe to handle or work with. The mechanical effect of fibres in contact with skin may cause temporary itching. Therefore it is advisable to protect yourself (eyes, skin) as described with pictograms in Table 3.
- Trace metals are fixed within the stable chemical macro structure of the mineral fibres. Therefore these metals will not be released or become bio-available under normal growing conditions. The standard method of extraction and measurement of trace metals for mineral growing media is the standard EN 13651 *Soil improvers and growing media — Extraction of calcium chloride/ DTPA (CAT) soluble nutrients and elements*. This method mimics natural extraction from soil solution and therefore provides an accurate estimate of the bio-available trace metals. Typical leaching values for Grodan used substrate can be found in Table 2 which also shows the limits for extractable elements as stated in the European Ecolabel (*Commission decision (EU)*

2015/2099 of 18 November 2015 establishing the ecological criteria for the award of the EU Ecolabel for growing media, soil improvers and mulch). The leaching of trace metals in Grodan (used) substrate are well below EU Ecolabel limits.

This analysis confirms the safety of mineral wool for the environment. Although mineral wool fibres contain trace metals, under normal conditions these are only released in extremely small amounts.

Trace metals	typical values CAT leaching Grodan used substrates mg/kg dm	European Ecolabel (EU) No.2015/2099
Cadmium (Cd)	0-0,03	3
Chromium (Cr)	0-20	150
Copper (Cu)	3-7	100
Mercury (Hg)	<0.002	1
Nickel (Ni)	1-4	90
Lead (Pb)	0-0.5	150
Zinc (Zn)	4-100	300

Table 2 European Ecolabel limits for trace metal extraction of mineral substrates



**Cover exposed skin.
When working in
unventilated area wear
disposable face mask.**

The abrasive effect of fibres can be annoying, especially on sensitive skin. Therefore it is sensible to wear gloves and cover especially sensitive skin. In any working environment with a risk for high safe dust concentrations one should wear a disposable face mask.



**Clean area using
vacuum equipment.**

Brooms and compressed air are excellent at whirling dust into the air. When cleaning any dusty environment spraying with water before sweeping reduces dispersible dust and vacuum cleaning is recommended.



**Waste should be
disposed of according
to local regulations.**

Mineral wool waste is NOT classified as hazardous waste. Therefore it can be disposed of with normal construction waste. If special regulation exists this shall be followed.



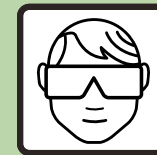
**Rinse in cold water
before washing.**

By rinsing your hands in cold water before washing, the pores in the skin will close making it easier for small particles and fibres to wash off.



**Ventilate working area
if possible.**

If there is any risk of high amounts of dust, an open window is always recommended.



**Wear goggles when
working overhead.**

When working overhead there is always an increased risk of particles falling into your eyes. Therefore, safety glasses are always recommended when working overhead.

Table 3 Handling information mineral wool products

Appendix 2 Examples of classifications applying to used substrate material

Classifications of Grodan used substrate material:

- European Waste Classification (EWC): 02 01 99 – *wastes from agriculture, horticulture, aquaculture, forestry, hunting, and fishing – wastes not otherwise specified*
- European Landfill Directive 2003/33/EC: classified as non-hazardous waste
- In Canada this material is classified as agricultural waste.

Classifications Grodan used substrate material (desleeved):

- Switzerland/France: Green list OECD – B2030 – *wastes containing principally inorganic constituents, which may contain metals and organic materials – ceramic wastes in non-dispersible form.*

Classifications of Reusable Substrate Granulate (RSG):

- European Waste Classification (EWC): EWC code 19 12 12 – *other wastes (non-hazardous, including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11*
- France (NFU norms) NF U 44-051: *Organic soil improvers – designations, specifications, and marking*; NF U 44-551: *Growing media – designations, specifications, and marking*
- United Kingdom/Wales: *Low risk activity LRW 442 (brick clay additive).*



Rockwool BV / Grodan

Industrieweg 15
P.O. Box 1160, 6040 KD Roermond
The Netherlands

t +31 (0)475 35 30 20
f +31 (0)475 35 37 16
e info@grodan.com
i www.grodan.com
in www.linkedin.com/company/grodan
🐦 www.twitter.com/grodan
@ [@grodaninternational](https://www.instagram.com/grodaninternational)



Grodan is a registered trademark of
ROCKWOOL INTERNATIONAL A/S.
© ROCKWOOL B.V. Grodan 2018.
All rights reserved.