Project no. 038644

BioNorm II

Pre-normative research on solid biofuels for improved European standards

SPECIFIC TARGETED RESEARCH OR INNOVATION PROJECT

PRIORITY [6-1] – Sustainable energy systems

DIII.11 Procedure for Quality Policy at companies

Due date of deliverable: month 36

Actual submission date: month 36

Start date of project:1/1/2007 Duration: 36 month

Task Leader organisation name: DBFZ German Biomass Research Centre

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PU	Public	X
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PRIORITY [6-1] – Sustainable energy systems

DIII.11: Improvement of QA & QC procedures demonstrated in CEN/TS 15234, part 2 - 6

Due date of deliverable: month 36

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Abstract

The development of European Standards (EN) is a precondition to expand the market for solid biofuels and a very important step to fulfil the political and environmental goals of the EU.

CEN/TC 335 has received a mandate from the European Commission (EC) to develop Standards for solid biofuels. The first step in the development of those Standards is the production of Technical Specifications (TS), which, after validation, will be upgraded to full European Standards.

The aim of the BioNorm II project is to carry out pre-normative research in the field of solid biofuels in close collaboration with the work of CEN TC 335 "Solid Biofuels". This includes the development of an overall quality assurance system for solid biofuels, their characterization and corpus of legislation.

This guideline is one of the outcomes of WPIII and provides information on how to develop and implement a Quality Assurance system within the solid biofuels business. It is not necessary to have a full quality-management system already in place to be able to apply the methodology contained in this guideline.

ISO 9001:2000; the relevant Standard for quality-management systems, defines Quality Assurance as the "part of Quality Management focussed on providing confidence that quality requirements will be fulfilled". To achieve that, the supply chain, i.e. the production and provision processes, must be in control. Effective control can be achieved only if Quality Assurance is being applied by each operator throughout the supply chain. A well-designed Quality Assurance system for solid biofuels can contribute to a more transparent and efficient biofuel market. Based upon the requirements of the customer, and the known strengths and weaknesses of a production process, a producer of biofuels can take appropriate measures to provide confidence that the desired quality is always met.

This drafted guideline is applicable for operators dealing with solid biofuels originating from the following sources:

- Pellets
- Wood Chips
- Hog Fuel
- Straw
- Olive Residues

In WP III the work focuses on the development of a comprehensive Quality Assurance System in order to guarantee a defined biofuel quality. The deliverable DIII.11 "Procedure for Quality Policy at companies" is foreseen to illustrate the adaptations of existing biofuel examples for wood pellets, wood chips, hog fuel, straw and olive residues, which have been published in CEN/TS 15234 (2005). With the help of the information from the former deliverables DIII.6, DIII.7, DIII.8, DIII.9 and DIII.10 and the feedback of TC 335/WG2 examples shall be improved to be more practical. For this reason not only the production process itself shall be regarded but also the whole supply chain from raw material supply to distribution.

In that context this deliverable describes the current situation within the different supply chains and points out the problems existing with regard to quality requirements. On this basis the biofuel examples will show how quality assurance and control can be performed in order to fulfil quality demands and requirements given by the different market actors. This will be done by concentrating on the generally relevant aspects traceability, production requirements and fuel quality declaration given in prEN 15234-1 Solid Biofuels – Fuel Quality Assurance – general requirements.

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1 Need for Quality Assurance for solid biofuels

The term solid biofuels encompasses a wide range of materials with differences in provenance and properties, as well as supply chains. Standardisation of biofuel properties and their sampling- and test-methods will provide tools to facilitate the businesses and actions of operators within the market, and to promote a more widespread use of biofuels /5/.

Such standardisation on its own cannot ensure an increase in the market for solid biofuels. In order to achieve the confidence of customers and regulators it is also essential that it can be demonstrated that the demanded level of quality is reached, and that adequate controls are ensured throughout the supply chain. The demanded quality can be influenced by a series of different factors that are determined by technology, and to a greater extent, by management.

Consumers (end users) are, or become aware of variations in quality; and consequently, large consumers often test for properties that are important in the context of the value of the solid biofuel they receive. In the extreme case, the lot may be rejected when its quality is below a certain minimum level. If fuel-producers and suppliers want to avoid such a rejection, they must introduce controls over their processes, up to the points of delivery at the consumers' premises.

The term "*demanded quality*" refers not only to standardised properties but to all requirements of customers. Those requirements differ from case to case in a wide range of possible circumstances. Most circumstances will lie between two extreme cases /5/:

(a) small-scale end users (especially domestic) who require high-grade fuels with narrow fuel specifications, and

(b) large-scale end users who can take advantage of lower-cost raw materials by the use of appropriately designed, fuel-flexible combustion plant.

2 Terms and definitions

2.1 The four pillars of Quality Management

The language and methods used in this guideline is compatible with, but not limited to, ISO 9000:2000 and ISO 9001:2000, the most commonly used Quality Management standard-family. ISO 9001:2000 already provides an overview of the system requirements that should be included when designing Quality Management systems. Quality Management is based on four pillars, as shown in Figure 1 below. The application of these pillars and their different measures depends on the problem and question regarded.

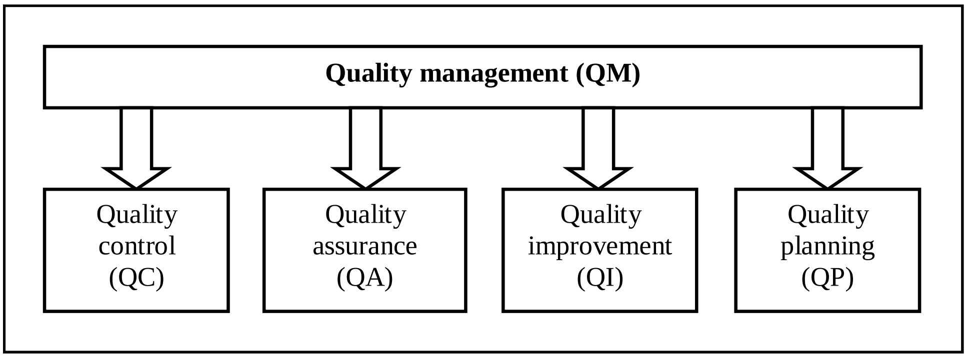


Figure1: Main pillars of Quality Management according to ISO 9000:2000, /5/

The pillars are defined as follows:

QC: Part of QM, focused on fulfilling quality requirements.
QA: Part of QM, focused on providing confidence that quality requirements will be fulfilled.
QI: Part of QM, focused on increasing the ability to fulfil quality requirements.
QP: Part of QM, focused on setting quality objectives and specifying necessary operational processes and resources to fulfil the quality objectives /5/.

Each of these quality tools has its own measures and approaches. The characteristic of the supply chain for solid biofuels places emphasis on Quality Assurance and Quality Control. Quality Assurance measures should

(a) be simple to operate,

(b) not cause undue bureaucracy, and

(c) offer savings in costs to both producers and users.

Quality Control is important to assess the properties of the fuel achieved, but it does not directly affect the quality of product. In the context of solid biofuels, Quality Control includes the selection and application of appropriate sampling and sample-reduction techniques, as well as test methods. However, the application of sample- and test-methods is expensive and should be applied carefully and not as a matter of routine.

An appropriate Quality Assurance system can reduce the frequency of testing and costs accordingly. Wherever possible, means should be sought to exempt parties from unnecessary procedures. Nevertheless, procedures should be drafted so that all steps in the supply chain are fully covered /5/.

2.2 Customer requirements

Quality Assurance aims to provide confidence that the quality required by the customer is continuously fulfilled. The fulfilling of these requirements leads to customer satisfaction.

The supply chains of solid biofuels can consist of different process chains and/or process steps, which can be distributed among different companies or organisational units. In this definition, the customer is not always the end-user of a solid biofuel but the next operator (company or organisational unit) within the supply chain. Each subsequent process chain or process step within the supply chain can be involved in defining the demanded quality.

In this regard, the fulfilling of customer requirements refers both to the product requirements as well as to the requirements in terms of the performance of the company. These aspects are controlled mainly by a company’s management. Quality in terms of Quality Assurance does not necessarily mean a high product–quality, but a steady and continually achieved quality in accordance with customer requirements.

2.3 Product quality

For solid biofuels to be accepted at the marketplace, it is important that the requirements of the customers, in terms of fuel properties, are fulfilled whether or not those requirements follow a fuel-Standard.

The quality of solid biofuels can be defined in terms of a number of key properties that relate to the suitability of the fuel for a specific use. The selection of these indicators can differ from case to case, depending on the foreseen application and the occurrence of natural variations in fuel characteristics under current production processes.

2.4 Quality of performance

This point can usefully be considered by the following questions:

(a) How does the company operate in terms of specific costs per unit of product?

(b) How does the company recognise and fulfil the customer needs?

(c) Is the work carried out both effectively and correctly?

Quality of performance therefore refers to documentation, timing and logistical issues. Figure 2 demonstrates the various aspects of demands on performances along the supply chain of solid biofuels.

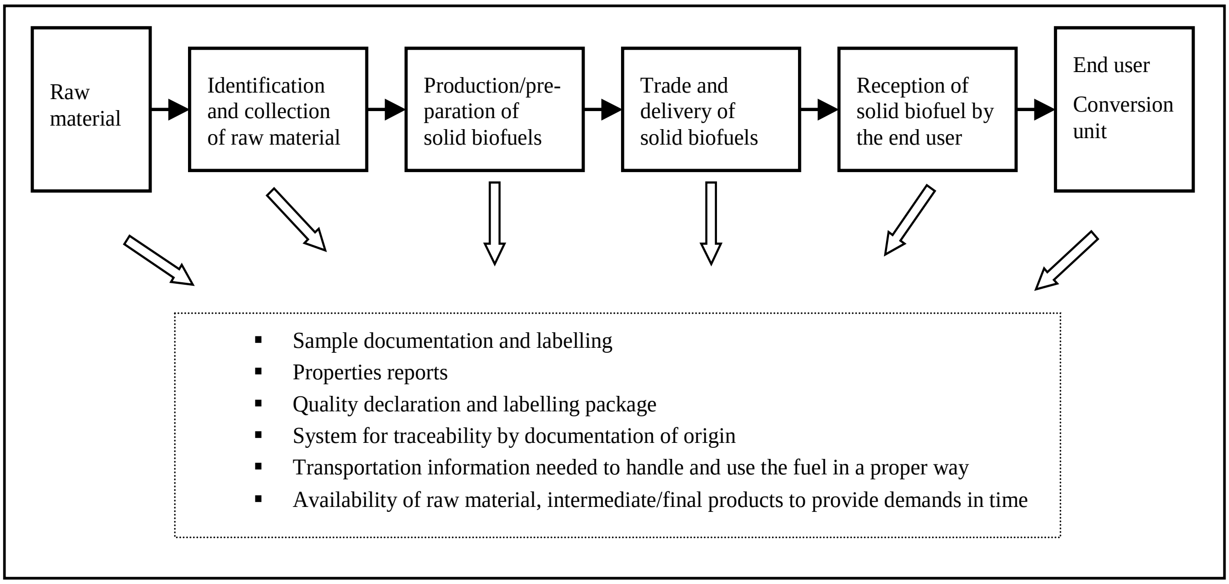


Figure 2: Aspects of demands on performances along the supply chain of solid biofuels, /5/

The documentation of information on raw materials, intermediate- and final products as well as production process parameters may be instrumental in safeguarding proper treatment of the material during the production process and later provide insight into weaknesses of the production process so as to constantly improve product quality.

3 Current situation in the biofuel supply chains and quality assurance measures according to prEN 15234-1 Fuel Quality Assurance - General Requirements

3.1 Wood pellets

Within the last ten years the use of wood pellets for heating purpose has experienced a fulminate development during which small scale user ask wood pellets with defined characteristics, which are adapted to the needs of the combustion unit. European wide exist more or less well established wood pellet standards on the market like e. g. ÖNorm M 7135 from Austria or DINplus from Germany. In future there will be a European standard for specification and classification of solid biofuels (prEN 14961), which will then replace national standards. Despite of production improvements in the last years, experiences and approaches of producers to the pellet production process are differently distinctive. However, this is also the result of the development of national markets and the accompanied supply-demand-situation for pellets. On the one hand high tech pellet units with high demands on the biofuel in central and northern Europe are sold; on the other hand rudimentary boilers are partly running in other parts of Europe, which are also suitable for other solid biofuels than wood pellets. From that context partly strongly different wood pellet qualities result. There is also the fact of increasing the pellet production capacities which is accompanied by additional raw material need. With the additionally required raw material also the interest on alternative raw materials as well as the international biofuel trade in Germany, Europe and worldwide increases.

Apart from this strength to strength happening European and worldwide market development for wood pellets a furthermore discussion about growing using competitions of biogene resources is held. In that context it is important to define standardised agreements about qualities to be traded on the one hand and about mechanisms for controlling required qualities on the other hand in order to fulfil quality standards in spite of broadened raw material range and widening of purchasing areas anyway. Meant by this are clear agreements, fixing of responsibilities and handing over interfaces between producer, supplier and end-user, which enable a pursuit of material flows. Furthermore regularly controls within the supply chain at control points, where the quality of the product can be influenced significantly, are essential.

In order to fulfil sustainability standards and to exclude inappropriate raw materials it is moreover essential to document the origin of raw materials. For pellet producer it is relevant to know that the first operator is responsible for the documents being prepared the first time. The documents shall be available and provided on justified request throughout the entire supply chain. In that context the first operator in the supply chain is a body or enterprise, which operates at the beginning of the supply chain.

For optimisation of the wood pellet supply information about influencing factors, quality control points, test methods and frequencies are given therefore in the following draft (see below). For instance the use of appropriate wood materials for pellet production can consequently be influenced during supply or harvest by choosing only fresh and healthy wood. If the wood is not debarked for pellet production, mineral impurities of the bark have to be avoided, in order to prevent an increase of the ash content beyond the natural degree.

Further considerable aspects are transport and storage of all intermediate and final products within the pellet supply. The avoidance of impurities through transport and storage as well as the avoidance of moistness into the pellets are important quality criteria. As all handling processes result into the development of abrasion, which causes an increase of the amount of fines as well as the danger of dust explosion, it is essential to reduce the amount of fines regularly to < 1% by sieving.

Within the real pellet production regularly carried out product controls are a necessary and important part in order to check the wood pellets' quality and to make adaptations to the production process if necessary. Only through this procedure a continuous production of standardised quality which is required by the end-user is possible.

The following draft mirrors, as announced in the text, a representative example of a pellet production chain. In individual case single process steps might differ from the ones shown in the draft. The aim of quality assurance for wood pellets is to create European wide awareness for the fact that required quality from end-user need a consequent control along the whole supply chain. For this it is not important if the required quality refers to standards or individually met agreements. It is rather about delivering demanded quality to the end-user and therefore meet transparent and fixed down in writing agreements as well as to prove customers that the production of a high quality product has highest priority in the company.

Example of documenting requirements for the production of wood pellets according to prEN 15234-1 - Fuel Quality Assurance – General Requirements

Production requirements according to prEN 15234-1 are subdivided into six consecutive steps.

Step 1: Fuel specification of the final product

Step 2: Production description (documentation of steps in the production chain)

Step 3: Quality influencing factors including company performance

Step 4: Critical Control Points for compliance with the fuel specification

Step 5: Measures to give confidence that the specification(s) is/are being realised

Step 6: Routines of separate handling of nonconforming materials and biofuels

The following information will give a general overview about documenting the requirements for the production in a wood pellets supply chain.

Step 1. Fuel specification for the final product

The fuel specification is based on prEN 14961-1 general part, table 4 in case of individually met agreements. Quality pellets are produced according to prEN 14961-2, product standard for wood pellets.

Step 2. Production description (documentation of steps in the production chain)

The following flow sheet is a general example, which gives an overview about the whole supply chain for wood pellets. Relevant single process steps in the supply chain are illustrated. In individual case the flow sheet for one single process step must be illustrated more detailed.

NOTE The illustration given is only a general example. The individual process chain might look differently at single process steps.

NOTE The location, where raw material for wood pellet production is harvested has an influence on single parameters. Big differences with regard to e. g. silicates, which influence the ash content, occur European wide. This has to be taken into consideration when illustrating a supply or rather production chain and its respective design.

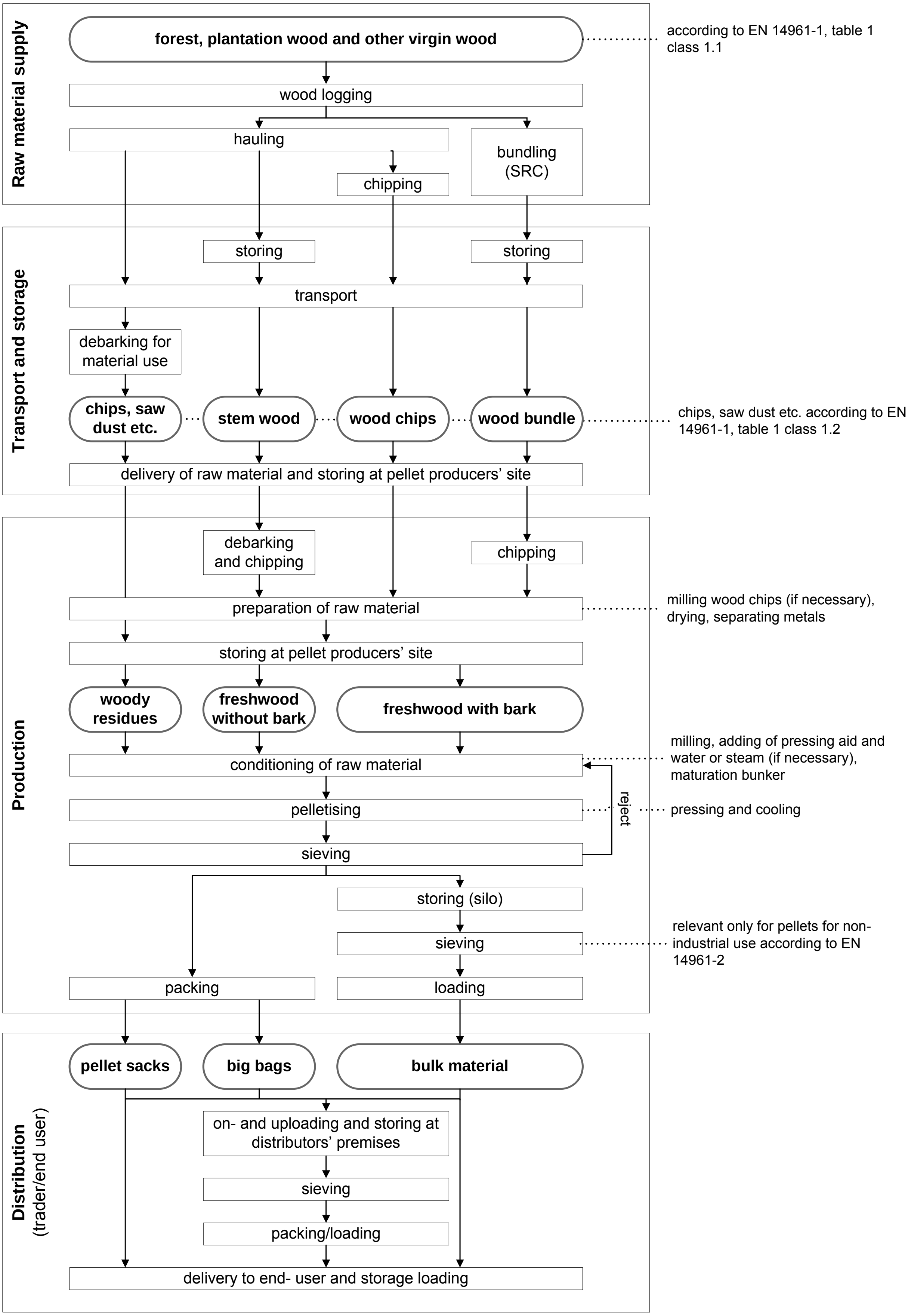
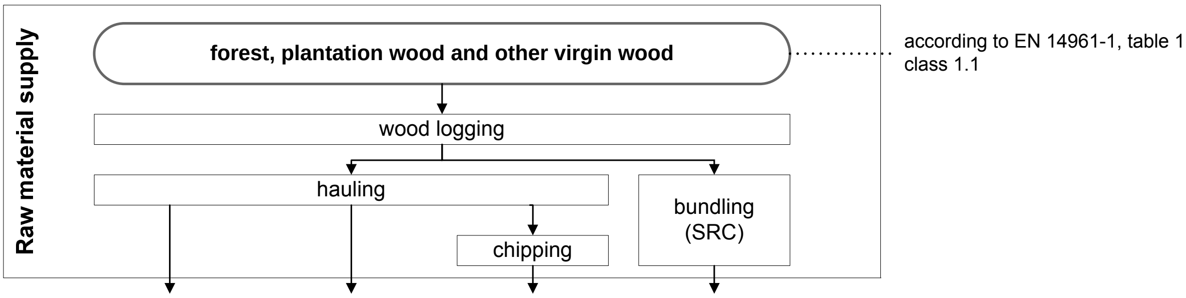


Figure 1 – An example of a wood pellet supply chain

The following tables summarize steps two to five and give information about quality influencing factors (step 3), Critical Control Points (step 4) and appropriate quality measures (step 5) for each single process step (see figure 1).

Step 2: Production description – Raw material supply



Step 3: Quality influencing factors

- species of wood / origin
- quality of wood [a)]
- impurities [b)]

Step 4: Critical Control Points

wood logging

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or other sensory inspections across the whole raw material supply process,
- singular testing of soil, where the raw material is generally harvested from, in advance gives important information about slagging elements in the wood and helps to calculate required pellet quality,

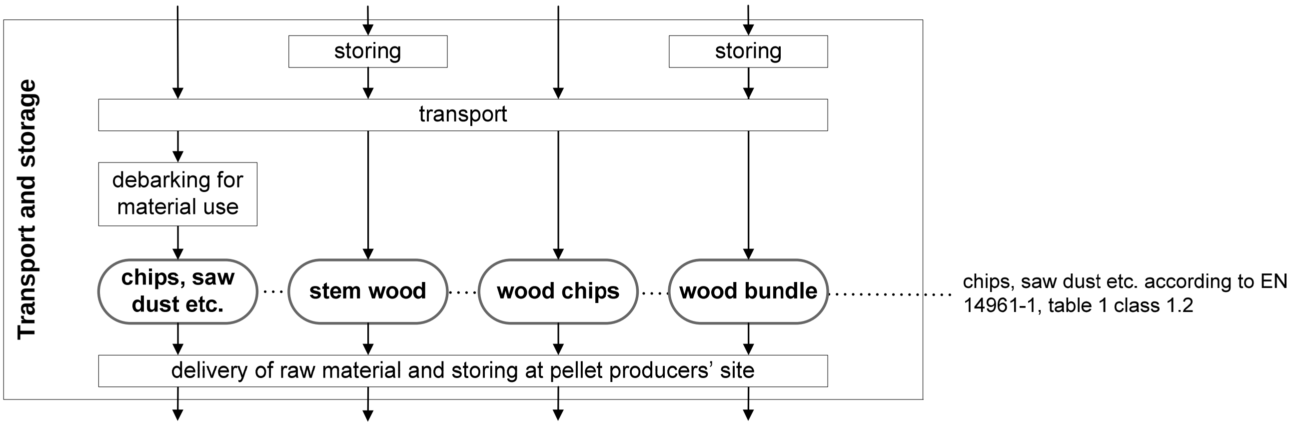
NOTE. This measure is on voluntary basis and especially useful when new pellet plants are built and the area where the raw material is mostly harvested from is known.

- only fresh and healthy wood without a beginning decomposition and without insect damage or insect attack will be used,
- contract between supplier and producer with "terms of delivery" including fuel specifications and biofuel handling.

[a)] Quality of wood: Fresh and healthy wood without beginning decomposition and without insect damage or insect attack. In mixtures also used wood can be used, which is not demolition wood.

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

Step 2: Production description – Transport and storage



Step 3: Quality influencing factors	Step 4: Critical Control Points
• quality of wood [a)] • impurities [b)] • weather conditions [c)] • storage time • bark	storing of whole trees and wood bundles storing after delivery of saw dust, stem wood, wood chips and/or wood bundles at pellet producers' site
• cleanliness of transportation unit	transport of saw dust and/or wood chips
• checking material quality • species of wood / origin	delivery of saw dust, stem wood, wood chips and/or wood bundles

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

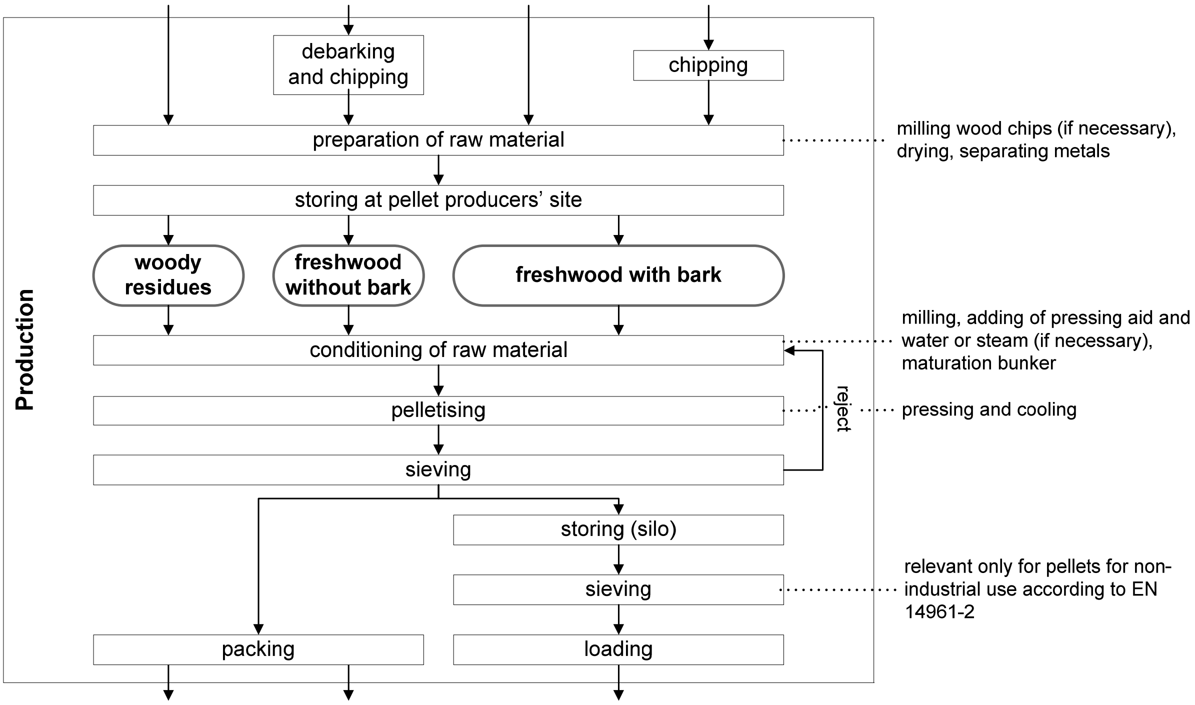
- carry out visual or other sensory inspections across the whole transport and storage process,
- storage areas have a clean and solid underground, which prevents an entry of impurities into the biofuel,
- storage areas are roofed or protected by tarpaulin or fleece to prevent an entry of moisture into the biofuel,
- transport equipment has to be free from impurities and has to protect the loading from rain or humidity,
- storage and transport equipment is checked regularly,
- contract between supplier and producer with "terms of delivery" including fuel specifications and biofuel handling.

[a)] Quality of wood: Fresh and healthy wood without beginning decomposition and without insect damage or insect attack. In mixtures also used wood can be used, which is not demolition wood.

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see prEN 14588)

[c)] Weather conditions: Temperature and rain influencing drying of wood and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

Step 2: Production description – Production



Step 3: Quality influencing factors	**Step 4: Critical Control Points**
• quality of wood [a)] • impurities [b)] • degree of dryness	chipper
• impurities [b)] • weather conditions [c)] • quality of wood [a)] • bark	storing at pellet producers' site
• quality of wood [a)] • impurities [b)]	conditioning of raw material with hammer mill
• dust formation • impurities in the transportation unit • suitability of the transportation unit NOTE: The end user shall receive wood pellets with an amount of fines ≤ 1% and which don't cause to much dust when delivering them. Additionally wood pellets have to be clean and free from impurities. For that purpose the transportation unit must be suitable for the transport of pellets and must be kept free from impurities in case of open transportation units.	loading station
• filling velocity	packing station

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or with sensory inspections across the whole production process,
- measurement of certain properties after the raw material basis has changed on a frequency appropriate to the process requirements;
- equipment is repaired or changed when necessary; some parts will require changing regularly according to their technical life time or the production control system,
- regularly calibration of humidity measurement on dryer

NOTE: In many drying processes the online humidity measurement after the drying process is an important debit value for the Process Light System of the dryer to control the belt speed e. g. for belt dryers This humidity measurement system has to be calibrated. It starts with a weekly control. If no adjustments are necessary the control can be performed every two weeks, every four weeks etc. Vibrations influence the measurement systems and lead to wrong measurement values after a while. The result is too wet or too dry saw dust in the storage.

- agreements between supplier and customer with regard to biofuel handling and quality,
- wood pellets are protected from moistness caused by snow, rain humid stonework or rather condensation moistness through a suitable storage
- storage areas, silos and haulage plants where wood pellets are handled, are kept free from impurities
- determination of properties after production
  1) using typical values, e. g. laid down in annex B of the prEN 14961-1, or obtained by experience;
  2) calculation of properties, e.g. by using typical values and considering documented specific values;
  3) carrying out of analysis: a) with simplified methods if available, b) with reference methods.

amount of fines:	prEN 15149-2
dimensions:	new work item in CEN TC 335 to come
moisture:	prEN 14774-1 to -3
mech. durability:	prEN 15210-1
ash:	prEN 14775
net calorific value:	prEN 14918,

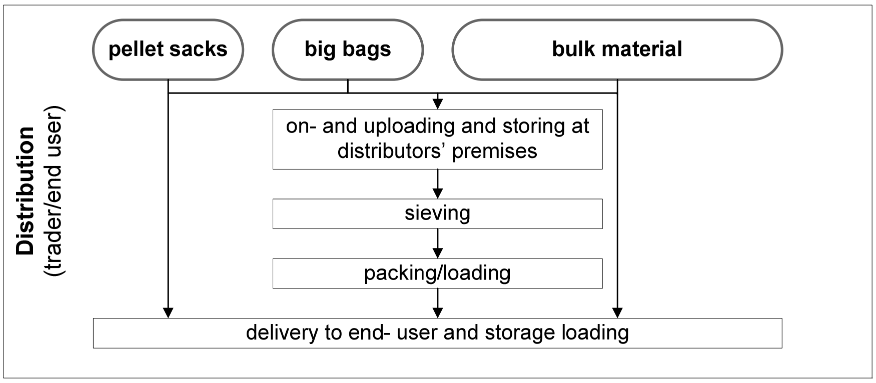
- mechanical durability, dimensions, moisture content are controlled every two to four hours,
- ash and net calorific value are checked if required,
- sieving and checking of fines every time pellets are filled into the silo; amount of fines ≤ 1% according to prEN 14961-2 unless no other agreements are met,
- pellet retain samples are taken every time pellets are loaded from silo to transportation unit,
- pellet retain samples are preserved approx. half a year at winter or spring delivery and approx. one year at summer delivery,
- production control, conditions and adjustment of the equipment (e. g. ampere of presses, temperature of koller bearings, vibration of presses).

[a] Quality of wood: Fresh and healthy wood without beginning decomposition and without insect damage or insect attack. In mixtures also used wood can be used, which is not demolition wood.

[b] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see prEN 14588)

[c] Weather conditions: Temperature and rain influencing drying of wood and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

Step 2: Production description – Distribution



Step 3: Quality influencing factors	Step 4: Critical Control Points
• dust formation • impurities in the transportation unit • air pressure in case of unloading with pressurized air • suitability of the transportation unit	on- and uploading at distributor's premises
• filling velocity	packing-station
• remaining material inside storage room • length of injection tube • material of hose (especially inside) • amount of bows • injection pressure	storage loading at end user's premises

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or with other sensory inspections across the whole distribution process,
- storage areas, silos and haulage plants are cleaned completely before conveying or storing pellets if other materials than wood pellets have been handled before,
- storing areas, where wood pellets are handled, are roofed
- transportation unit is constructed in a way that protects wood pellets from moistness
- moisture content analysis before delivery to the end user after a long time intermediate storage,
- sieving of fines, amount of fines ≤ 1% according to prEN 14961-2 unless no other agreements are met,
- determination of properties after delivery from pellet plant for loose material if required and when pellet distributor changes
  1) using typical values, e.g. laid down in annex B of the prEN 14961-1, or obtained by experience;
  2) calculation of properties, e.g. by using typical values and considering documented specific values;
  3) carrying out of analysis: a) with simplified methods if available, b) with reference methods.

amount of fines:	prEN 15149-2
dimensions:	new work item in CEN TC 335 to come
moisture:	prEN 14774-1 to -3
mech. durability:	prEN 15210-1
ash:	prEN 14775
net calorific value:	prEN 14918,

NOTE. This measure is on voluntary basis.

- storage and transport equipment is checked regularly,
- air pressure during unloading is to be checked and stated in the supply protocol,
- contract between producer and distributor with “terms of delivery” including fuel specifications and biofuel handling

Step 6. Routines for separate handling of nonconforming materials and biofuels

If wood pellets are not fulfilling the requirements, these batches have to be stored separately from conforming biofuel. All necessary information has to be filed. If nonconformity is discovered at the premises of the consumer in connection with delivery, a nonconformity report is generated and handling of the nonconforming lot is agreed with the consumer.

Signature of assigned person Place and date

NOTE This example represents an individual plant or process. The document requirements vary depending on the situation and complexity of the process.

3.2 Wood chips

Wood chips are produced from woody residues, landscape management wood and/or short rotation coppice and can basically be used for combustion purpose as well as for landscape design. As wood chips for combustion require more narrow specifications than those used for design purpose it is important to separate material suitable for energetic use from unsuitable one. This is e. g. true for composted wood material that can be used for gardening issues but not in small scale users' combustion boilers.

At the moment the wood chips market is characterised by many small wood chips producer chipping wood in regional forest and/or landscape areas. That's why the wood chips market is more decentralized organised than for instance the wood pellets market. Current problems result i. a. from impurities in the wood chips like sand or stones or too even too needles or leaves. Sometimes also plastics or papers can be found in the material if it is not sufficiently cleaned after harvesting of landscape management wood. Dirty transportation units also result into wood chips that are polluted with either other bio materials (e. g. straw, manure) or non-biological ones.

For guaranteeing wood chips quality adapted to the needs of the combustion unit quality assurance is essential to control the quality and to optimise interactions between supplier, producer and end-user and to perform adaptations of the wood chips supply if necessary. For this reason information about influencing factors, quality control points, test methods and frequencies are given therefore in the following draft (see below).

After harvesting the raw material there are two possible paths for the further processing of the material. On the one hand the fresh material can be chipped (with sharp tools) directly for a just-in-time delivery. The resulting wood chips have moisture content around 50 % and are foreseen for heat (and power) plants that can handle high moisture contents and also a certain degree of impurities like minerals etc.

Small and medium scale plants require a biofuel with moisture content around 20 – 25 % and a defined particle size between P16 and P45. If thin branches are intended to be used it has to be checked if the required particle size can be achieved. Otherwise they can be mixed to the respective charge to a certain amount, so that the demanded threshold value for fine fraction is not exceeded.

For a smooth running of the small or medium scale combustion unit impurities like sand, stones as well as needles and/or leaves which increase the amount of fines and the ash content have to be removed. For this reason a second path for processing wood chips collects and seasonally stores woody raw material for a certain period of time, in order to reduce the moisture contend to an adequate level for small and medium scale combustion units and to make needles and/or leaves fall of the stem through the drying process. This is also important to make wood chips storable over a longer period of time.

After seasoning the material has to be additionally cleaned from needles and leaves if this didn't happen successfully enough during seasoning in order to keep the ash content as low as possible. When chipping the wood it is up to the (plant) operator to produce the correct wood chips size by adjusting the settings of the chipping machine. Depending on the required quality an additional drying might become necessary as well as a sieving process that sorts out fines and coarse fraction. The produced wood chips are delivered as bulk material on trucks or tractor trailers that should be kept free from impurities that affect the desired raw material quality.

Example of documenting requirements for the production of wood chips according to prEN 15234-1 - Fuel Quality Assurance – General Requirements

Production requirements according to prEN 15234-1 are subdivided into six consecutive steps.

Step 1: Fuel specification of the final product

Step 2: Production description (documentation of steps in the production chain)

Step 3: Quality influencing factors including company performance

Step 4: Critical Control Points for compliance with the fuel specification

Step 5: Measures to give confidence that the specification(s) is/are being realised

Step 6: Routines of separate handling of nonconforming materials and biofuels

The following information will give a general overview about documenting the requirements for the production in a wood chips supply chain.

Step 1. Fuel specification for the final product

The fuel specification is based on prEN 14961-1 general part, table 5 in case of individually met agreements. Quality wood chips are produced according to prEN 14961-4, product standard for wood chips.

Step 2. Production description (documentation of steps in the production chain)

The following flow sheet is a general example, which gives an overview about the whole supply chain for wood chips. Relevant single process steps in the supply chain are illustrated. In individual case the flow sheet for one single process step must be illustrated more detailed.

NOTE the illustration given is only a general example. The individual process chain might look differently at single process steps.

NOTE the location, where raw material for wood chip production is harvested has an influence on single parameters. Big differences with regard to e. g. silicates, which influence the ash content, occur European wide. This has to be taken into consideration when illustrating a supply or rather production chain and its respective design.

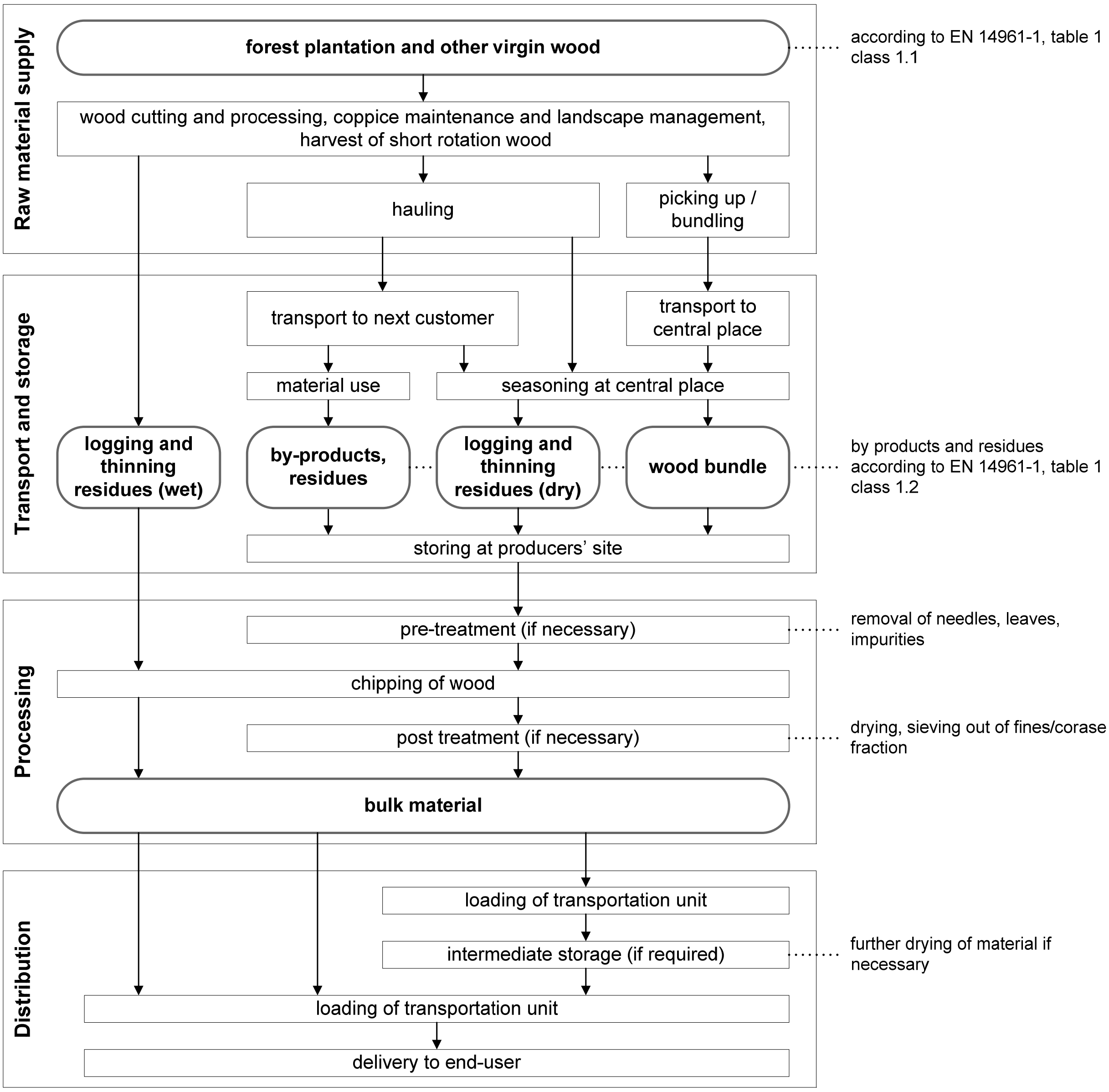
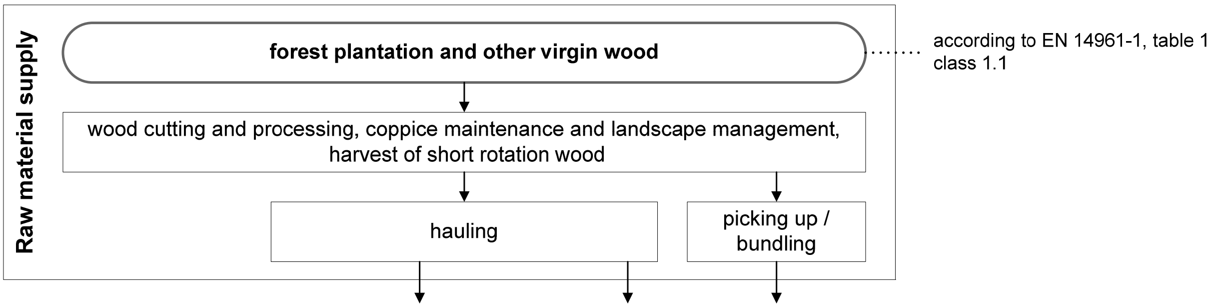


Figure 2 – An example of a wood chips supply chain

The following tables summarize steps two to five and give information about quality influencing factors (step 3), Critical Control Points (step 4) and appropriate quality measures (step 5) for each single process step (see figure 1).

Step 2: Production description – Raw material supply



Step 3: Quality influencing factors	Step 4: Critical Control Points
• trunk/branch diameter • species of wood • quality of wood [a)] • impurities [b)]	wood cutting and processing, coppice maintenance and landscape management, harvest of short rotation wood
• weather conditions [c)]	hauling
• quality of wood [a)] • impurities [b)]	picking up / bundling

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

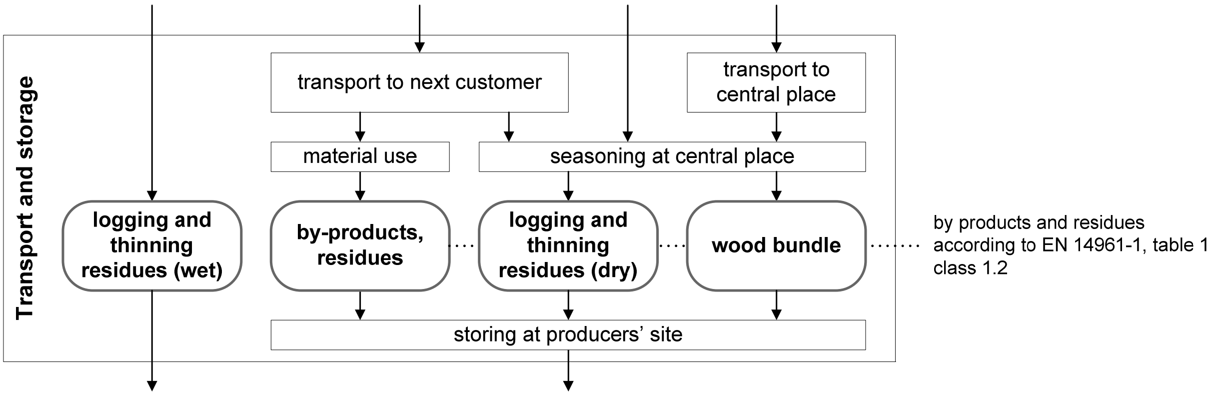
- carry out visual or other sensory inspections across the whole raw material supply process,
- only fresh and healthy wood without a beginning decomposition and without insect damage or insect attack will be used,
- agreements between supplier and customer with regard to biofuel handling and quality,
- contamination is controlled by visual inspection;
- impurities like waste, plastics, paper, sand, stones etc. have to be removed,
- appropriate use for energetic use of raw material is checked.

[a)] Quality of wood: Fresh and healthy wood without beginning decomposition and without insect damage or insect attack. In mixtures also used wood can be used, which is not demolition wood.

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see prEN 14588)

[c)] Weather conditions: Temperature and rain influencing drying of wood and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

Step 2: Production description – Transport and storage



Step 3: Quality influencing factors

- weather conditions [c)]
- piling construction of trees
- needles and leaves
- impurities [b)]
- storage time

Step 4: Critical Control Points

seasoning at central place

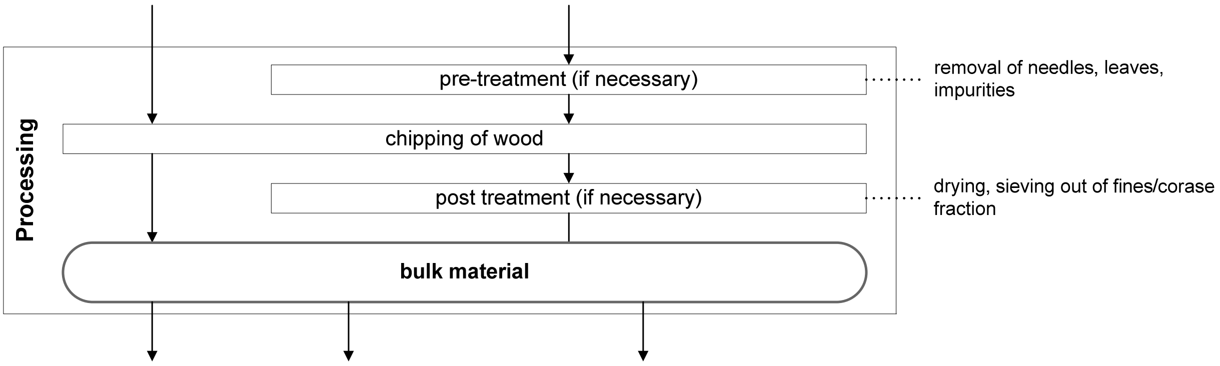
Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or other sensory inspections across the whole transport and storage process,
- storage areas have a clean and solid underground, which prevents an entry of impurities into the biofuel,
- contamination is controlled by visual inspection;
- impurities like waste, plastics, paper, sand, stones etc. have to be removed,
- agreements between supplier and customer with regard to biofuel handling and quality.

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see prEN 14588)

[c)] Weather conditions: Temperature and rain influencing drying of wood and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

Step 2: Production description – Processing



Step 3: Quality influencing factors	Step 4: Critical Control Points
• needles and leaves • impurities [b)]	pre-treatment
• selection of chipping technique • settings of chipper	chipper
• belated drying • impurities [b)] • amount of fines and coarse fraction	post- treatment

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

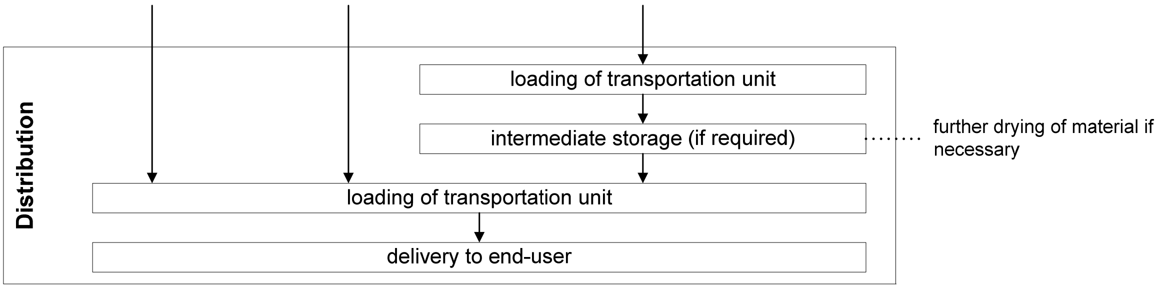
- carry out visual or with sensory inspections across the whole production process,
- equipment is repaired or changed when necessary; some parts will require changing regularly according to their technical life time or the production control system,
- agreements between supplier and customer with regard to biofuel handling and quality,
- determination of properties after production
  1) using typical values, e.g. laid down in annex B of the prEN 14961-1, or obtained by experience;
  2) calculation of properties, e.g. by using typical values and considering documented specific values;
  3) carrying out of analysis: a) with simplified methods if available, b) with reference methods.
  particle size: prEN 15149-1 to -2
  moisture: prEN 14774-1 to -3
  ash: prEN 14775
  net calorific value: prEN 14918
  bulk density: prEN 15103,

NOTE: The laboratory analysis according to 3) is on voluntary basis.

- checking sieve settings/ perforated basket
- sieving of fines,
- production control, conditions and adjustment of the equipment.

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see prEN 14588)

Step 2: Production description – Distribution



Step 3: Quality influencing factors

- impurities [b)]
- number of handlings
- construction of the transportation unit

Step 4: Critical Control Points

charging of the transportation unit

transport to end- user, next customer or storage building

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or with other sensory inspections across the whole distribution process,
- determination of properties after delivery from supplier if required and when supplier changes
  1) using typical values, e.g. laid down in annex B of the prEN 14961-1, or obtained by experience;
  2) calculation of properties, e.g. by using typical values and considering documented specific values;
  3) carrying out of analysis: a) with simplified methods if available, b) with reference methods.
  particle size: prEN 15149-1 to -2
  moisture: prEN 14774-1 to -3
  ash: prEN 14775
  net calorific value: prEN 14918
  bulk density: prEN 15103,

NOTE: The laboratory analysis according to 3) is on voluntary basis.

- storage and transport equipment is checked regularly,
- air pressure during unloading is to be checked and stated in the supply protocol,
- agreements between supplier and customer with regard to biofuel handling and quality.

[a)] Quality of wood: Fresh and healthy wood without beginning decomposition and without insect damage or insect attack. In mixtures also used wood can be used, which is not demolition wood.

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

[c)] Weather conditions: Temperature and rain influencing drying of wood and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

Step 6. Routines for separate handling of nonconforming materials and biofuels

If any deviations from the wood chips requirements are observed, deviating batches are separated from the rest of the wood chip lot if possible. The next operator is informed if any deviating wood chips are delivered. A document of nonconformity is filed and the reasons for the deviations investigated.

Signature of assigned person Place and date

NOTE This example represents an individual plant or process. The document requirements vary depending on the situation and complexity of the process.

3.3 Hog fuel

Hog fuel can be produced from different raw materials. Besides of natural wood (like untreated log wood) hog fuel can also be produced from used wood. Hog fuel from used wood becomes available with waste recycling companies as a by-product from building demolition activities or as a by-product from the wood processing industry.

The raw material is usually already source separated and stored in different piles or storages for different classes of used wood. Used wood is then transported from these storages of waste wood collectors to the processing plant on trucks, by ship (see picture below) or by train.

Figure 3 – Ship loading of category B-wood /1/

The raw material that is supplied to the processing company is first manually checked to verify the quality that is stated (clean wood, painted, impregnated, etc.) before it is temporarily stored in different piles or storages for different classes of used wood.

The hog fuel is then produced by size reduction and removal of impurities like metals and sand. In contrast to wood chips that are typically cut with relatively sharp knives, size reduction of hog fuel is typically carried out by cutting with relatively blunt tools using a shredder (see picture below). The size of hog fuel can be adapted with the settings of the shredder and the mesh size of the sieve.

Figure 4 – Shredder to reduce the category B-wood size /1/

The produced hog fuel is temporarily stored before delivery. The hog fuel is delivered to the end user as bulk material on trucks or ships or by train. The hog fuel is used in both dedicated small boilers and larger multifuel combustion furnaces, like grate furnaces, fluidised bed boilers and cofiring facilities.

The production of hog fuel is not a constant process in general, but is strongly influenced by the possibility to obtain contracts for supply of suitable raw materials and the weather conditions and season.

Current quality measures

Visual control is the common quality control measure. Visual control is applied at:

1. sorting of chemically treated and untreated used wood,
2. reception of the used wood at the processing company,
3. loading of the hog fuel for transportation at the processing company,
4. reception of the hog fuel at the end consumer.

Additional current quality measures include:

- sampling and analysis of hog fuel.
- moisture analysis on a regular basis, and
- periodically ash content, particle size and net calorific value.

The frequency of analysis is dependent on the fuel contract between supplier (biofuel producer) and consumer (power plant).

Moisture content, particle size, impurities and ash content are considered to be the most important hog fuel parameters from the consumer point of view. Moisture content is except from sample analysis hardly controlled by quality measures. Particle size is dependent on the shredder and the mesh sizes of the sieves. Impurities from painted wood and cupboard are controlled by visual control during selection at the raw material suppliers.

Improvement with prEN 15234

With prEN 15234 quality measures can be formulated to improve the fuel quality parameters, which are normally agreed upon in the fuel supply contract between supplier and consumer of hog-fuel.

On top of the before mentioned current quality measures, the following measures will improve the confidence that quality requirements will be fulfilled:

1. Protection of hog fuel from rain and moisture by covering storage areas and transportation equipment with roofs, fleeces or tarpaulin
2. Protection of hog fuel from sand and moisture by storage on a clean surface
3. Loading and off-loading of hog fuel with clean equipment
4. Regular control of the proper condition of size reduction equipment (shredder), sieves and equipment for metal separation
5. Sampling of each load of hog fuel and conditioned storage of the samples for a periode of at least 1 year. This enables the possibility to perform analysis in cases of disputes between the hog fuel supplier and the consumer.

Example of documenting requirements for the production of hog fuel according to prEN 15234-1 - Fuel Quality Assurance - General Requirements

Production requirements according to prEN 15234-1 are subdivided into six consecutive steps.

Step 1: Fuel specification of the final product

Step 2: Production description (documentation of steps in the production chain)

Step 3: Quality influencing factors including company performance

Step 4: Critical Control Points for compliance with the fuel specification

Step 5: Measures to give confidence that the specification(s) is/are being realised

Step 6: Routines of separate handling of nonconforming materials and biofuels

The following information will give a general overview about documenting the requirements for the production in a wood pellets supply chain.

Step 1. Fuel specification for the final product

The fuel specification is based on prEN 14961-1 general part, table 6 in case of individually met agreements.

Step 2. Production description (documentation of steps in the production chain)

The following flow sheet is a general example, which gives an overview about the whole supply chain for hog fuel from used wood. Relevant single process steps in the supply chain are illustrated. In individual case the flow sheet for one single process step must be illustrated more detailed.

NOTE the illustration given is only a general example. The individual process chain might look differently at single process steps.

NOTE the location, where raw material for hog fuel production is stored has an influence on single parameters. Big differences with regard to e. g. silicates, which influence the ash content, occur European wide. This has to be taken into consideration when illustrating a supply or rather production chain and its respective design.

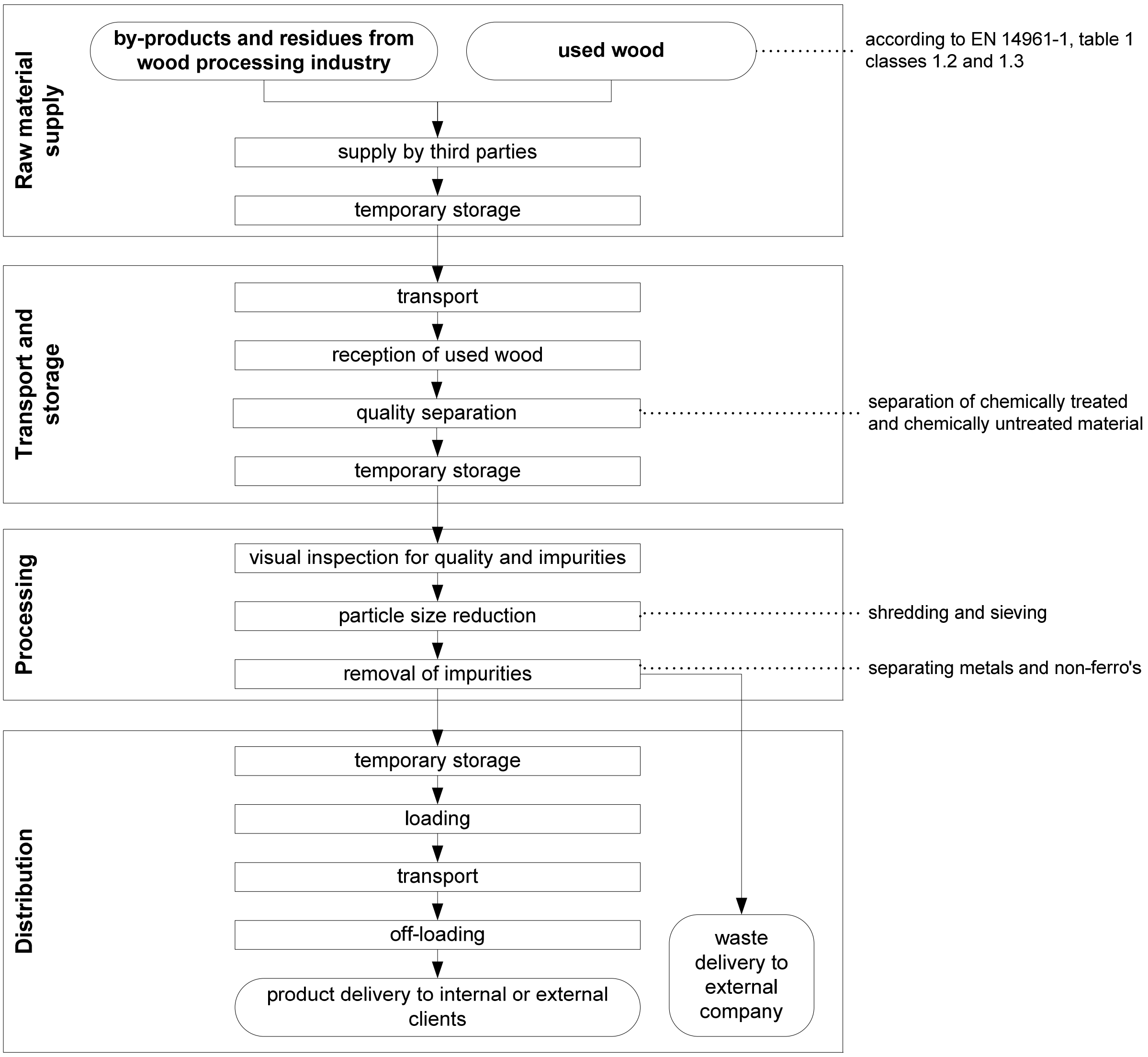
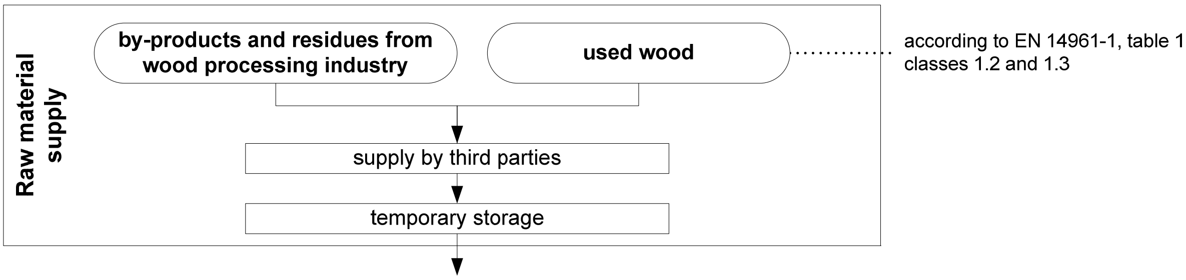


Figure 5 – An example of a hog fuel supply chain

The following tables summarize steps two to five and give information about quality influencing factors (step 3), Critical Control Points (step 4) and appropriate quality measures (step 5) for each single process step (see figure 1).

Step 2: Production description – Raw material supply



Step 3: Quality influencing factor	Step 4: Critical Control Points
• impurities [a)] • moisture content • ash content	supply of/by third parties
• weather conditions [b)]	storage of raw material

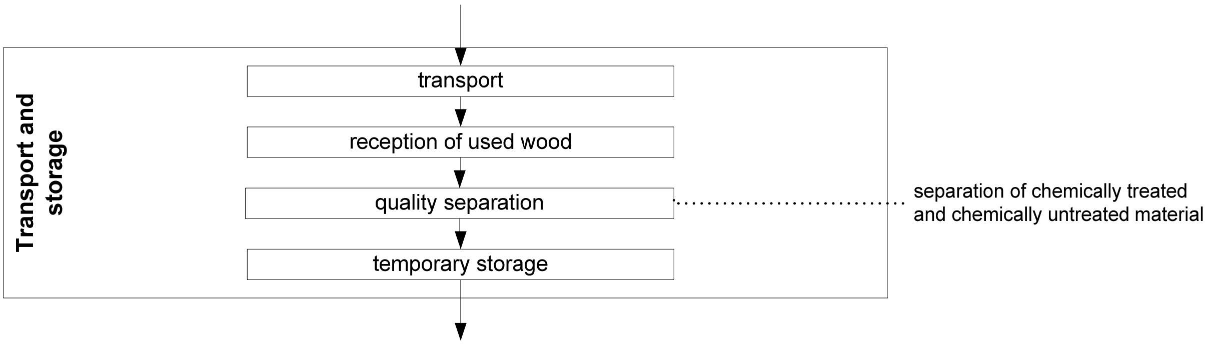
Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or other sensory inspections across the whole raw material supply process,
- pre-selection of chemically untreated and treated wood by sorting during supply by third partners,
- agreements between supplier and customer with regard to hog fuel handling and quality.

[a)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

[b)] Weather conditions: Temperature and rain influencing moisture content and impurities like sand, stones etc.

Step 2: Production description – Transport and storage



Step 3: Quality influencing factor	Step 4: Critical Control Points
• impurities [a)] • moisture content • ash content	reception of used wood
• weather condition [b)]	storage of raw material

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or other sensory inspections across the whole transport and storage process,
- storage areas have a clean and solid underground, which prevents an entry of impurities into the hog fuel,

NOTE: storage of wood by products and used wood is usually done on a metal floor (containers, ships, lorries).

- storage areas are roofed or protected by tarpaulin or fleece or a metal roof to prevent an entry of moisture into the hog fuel,
- loading and transport equipment has to be free from impurities and has to protect the loading from rain or humidity,
- storage and transport equipment is checked regularly,
- control of off-loading received loads on heaps by biofuel operator

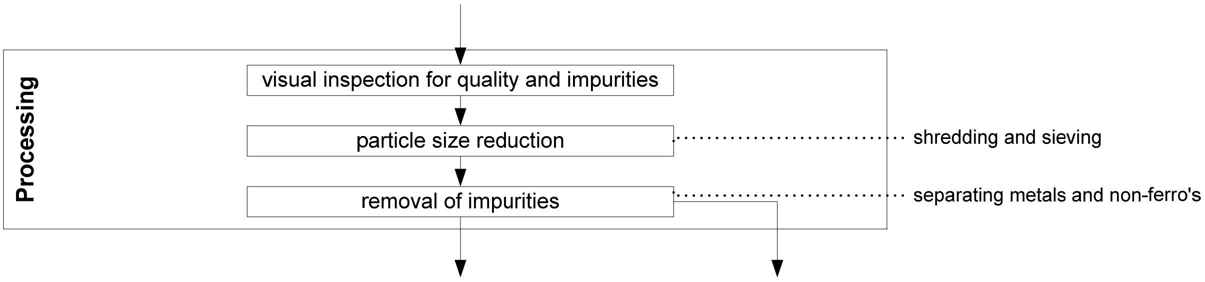
NOTE: received loads are usually off-loaded on separate heaps for chemically treated and untreated wood

- sampling of received loads at the hog fuel processing company and subsequent storage of samples,
- agreements between supplier and customer with regard to hog fuel handling and quality.

[a)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

[b)] Weather conditions: Temperature and rain influencing moisture content and impurities like sand, stones etc.

Step 2: Production description – Processing



Step 3: Quality influencing factor	Step 4: Critical Control Points
• particle size	shredder (size reduction)
• impurities [a]	metal separation, non Ferro separation

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

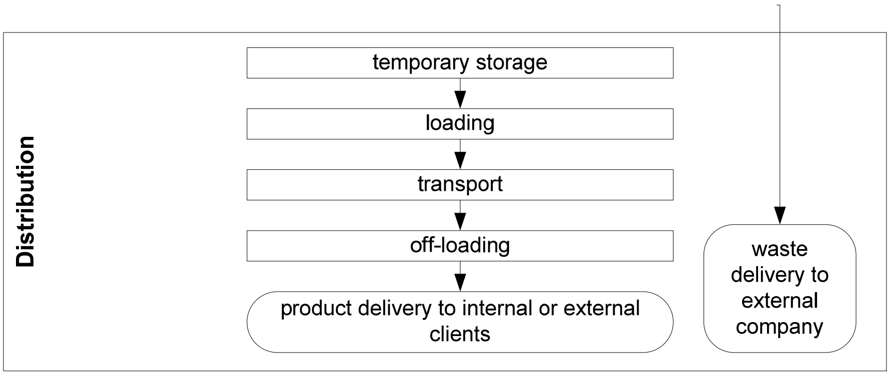
- carry out visual or with sensory inspections across the whole production process,
- equipment is repaired or changed when necessary; some parts will require changing regularly according to their technical life time or the production control system,

NOTE: hog fuel is prepared with blunt tools, like a shredder.

- determination of properties after production
  1) using typical values, e. g. laid down in annex B of the prEN 14961-1, or obtained by experience;
  2) calculation of properties, e.g. by using typical values and considering documented specific values;
  3) carrying out of analysis: a) with simplified methods if available, b) with reference methods.
  dimensions: new work item in CEN TC 335 to come
  moisture: prEN 14774-1 to -3
  ash: prEN 14775
  net calorific value: prEN 14918,
- agreements between supplier and customer with regard to hog fuel handling and quality,
- retain hog fuel samples are taken every time pellets are loaded from storage to transportation unit,
- hog fuel retain samples are preserved approx. one year at summer delivery for post analysis purposes,
- production control, conditions and adjustment of the equipment (e. g. shredder size, sieve mesh size, strength of magnets).

[a] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

Step 2: Production description – Distribution



Step 3: Quality influencing factor	Step 4: Critical Control Points
• moisture content • impurities [a)] • ash content	loading at traders/producers premises
• moisture content • impurities [a)] • ash content	transport
• moisture content • impurities [a)] • ash content	off-loading at end users premises

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or with other sensory inspections across the whole distribution process,
- protection of hog fuel from moisture by/through a suitable storage
- storage areas for produced hog fuel are kept free from impurities
- moisture content analysis before delivery to the end user after a long time intermediate storage,
- determination of properties after delivery at customer for loose material if required
  1) using typical values, e.g. laid down in annex B of the prEN 14961-1, or obtained by experience;
  2) calculation of properties, e.g. by using typical values and considering documented specific values;
  3) carrying out of analysis: a) with simplified methods if available, b) with reference methods.
  dimensions: new work item in CEN TC 335 to come
  moisture: prEN 14774-1 to -3
  ash: prEN 14775
  net calorific value: prEN 14918,
- storage and transport equipment is checked regularly,
- air pressure during unloading is to be checked and stated in the supply protocol,
- agreements between supplier and customer with regard to hog fuel handling and quality.

[a)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

Step 6. Routines for separate handling of nonconforming materials and biofuels

If hog fuel is not fulfilling the requirements, these batches have to be stored separately from conforming hog fuel. All necessary information has to be filed. If nonconformity is discovered at the premises of the consumer in connection with delivery, a nonconformity report is generated and handling of the nonconforming lot is agreed with the consumer.

Signature of assigned person　　　　　　　　　　　　Place and date

NOTE This example represents an individual plant or process. The document requirements vary depending on the situation and complexity of the process.

3.4 Straw

The major challenge in straw quality management is, that for a given year, the weather is the one dominant factor determining the possibilities of producing high quality straw for combustion. So securing straw in sufficient amounts and of an acceptable quality is more a matter of implementing routines and actions, which over a number of years will optimize the production and improve the average straw quality.

Demands for straw quality may vary a lot between different consumers, mostly depending on receiving facilities and combustions technology. Therefore it is not desirable to introduce very specific general demands for straw quality to be applied universally. For instance when taking into account the above mentioned dependency on annual variations in weather conditions, it is good to have some consumers which are able to accept straw of poorer quality.

In general there are no major problems (except for the weather) in producing straw of acceptable quality. As in most cases, it’s matter of skilled staff with experience in their field. However some recommendations can be given, which (not taking into account the weather) in general will produce high quality straw:

- remove bales from the field immediately after baling (if they are dry enough)
- swaths harvested with too high moisture content can remain untouched until they are dry
- if raking is necessary, rake a couple of hours before baling, and be sure the rake does not go into the ground
- store straw bales in a barn with roof, walls and solid floor
- the most important single technical factor when producing high quality straw is the baling; that the straw has an acceptable moisture content before baling.

Example of documenting requirements for the production of straw according to prEN 15234-1 - Fuel Quality Assurance – General Requirements

Production requirements according to prEN 15234-1 are subdivided into six consecutive steps.

Step 1: Fuel specification of the final product

Step 2: Production description (documentation of steps in the production chain)

Step 3: Quality influencing factors including company performance

Step 4: Critical Control Points for compliance with the fuel specification

Step 5: Measures to give confidence that the specification(s) is/are being realised

Step 6: Routines of separate handling of nonconforming materials and biofuels

The following information will give a general overview about documenting the requirements for the production in a straw bale supply chain.

Step 1. Fuel specification for the final product

The fuel specification is based on prEN 14961-1 general part, table 4 in case of individually met agreements.

Step 2. Production description (documentation of steps in the production chain)

The following flow sheet is a general example, which gives an overview about the whole supply chain for straw. Relevant single process steps in the supply chain are illustrated. In individual case the flow sheet for one single process step must be illustrated more detailed.

NOTE the illustration given is only a general example. The individual process chain might look differently at single process steps.

NOTE the location (soil composition), where the straw is harvested may have significant influence on single parameters. This has to be taken into consideration when illustrating a supply or rather production chain and its respective design.

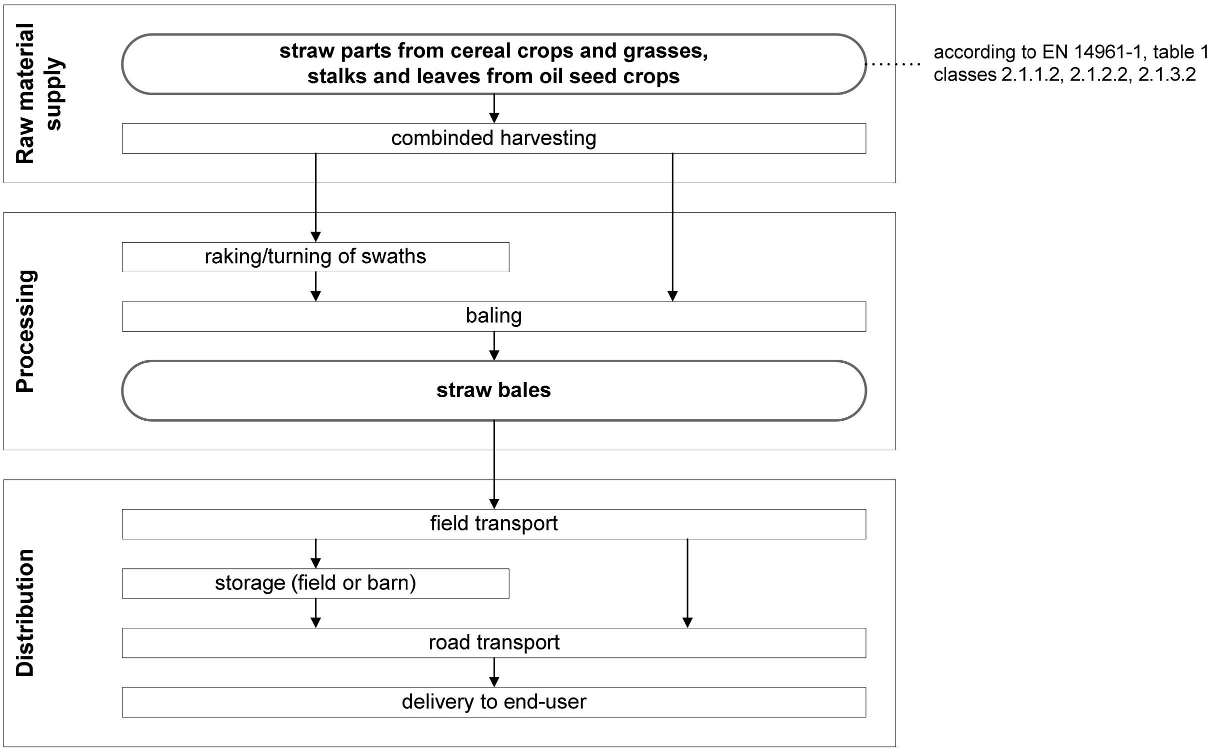
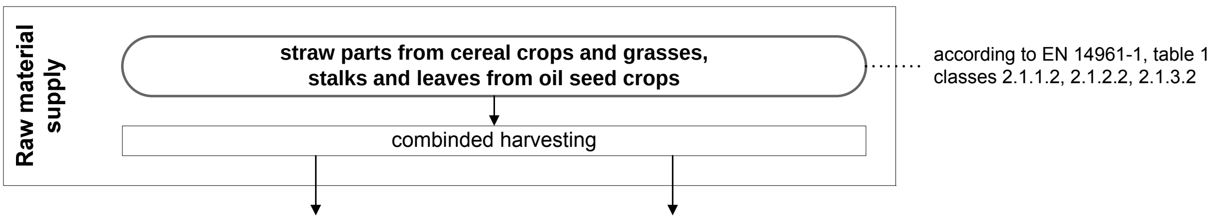


Figure 6 – An example of a straw supply chain

The following tables summarize steps two to five and give information about quality influencing factors (step 3), Critical Control Points (step 4) and appropriate quality measures (step 5) for each single process step (see figure 1).

Step 2: Production description – Raw material supply



Step 3: Quality influencing factors

- species of crop
- weather conditions [a)]

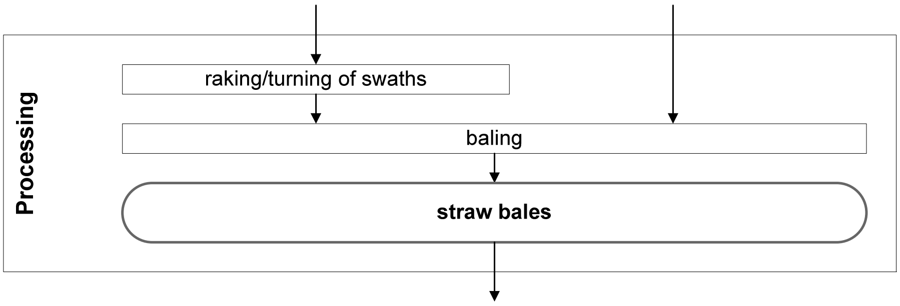
Step 4: Critical Control Points

Step 5: Measures to give confidence to the customers that the specification(s) is/are being realized

No specific measures at this point

[a)] Weather conditions: Rainfall during straw maturing period and after combined harvesting (but before baling) improves in general combustion characteristics of the straw by reducing straw content of Potassium and Chlorine.

Step 2: Production description – Processing



Step 3: Quality influencing factors

- weather conditions [a)]
- impurities [b)]
- moisture content
- dimensions and weight of bales

Step 4: Critical Control Points

raking/turning of crops

baling

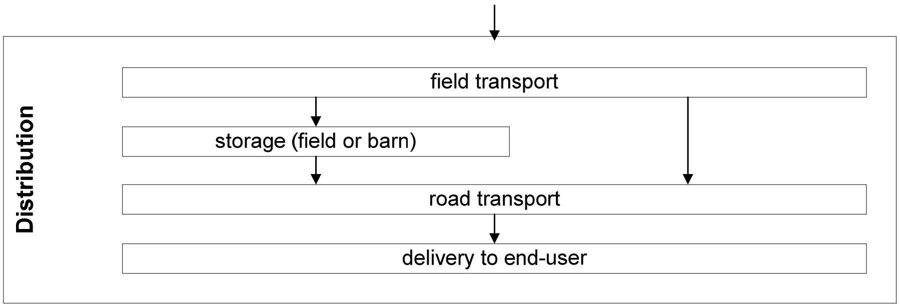
Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- checking moisture content in swaths before baling
- ensuring correct height of baler pick-up aggregate
- measuring moisture content in bales
- carry out visual inspection of bales
- checking bale dimensions
- contract between producer/supplier and customer with “terms of delivery” including fuel specifications

[a)] Weather conditions: Rainfall during straw maturing period and after combined harvesting (but before baling) improves in general combustion characteristics of the straw by reducing straw content of Potassium and Chlorine. If swaths are wet after rainfall, drying of swaths is necessary by raking/turning of swaths

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

Step 2: Production description – Distribution



Step 3: Quality influencing factors

- weather conditions [a)]
- impurities [b)]
- moisture content
- fungi and mould
- tarpaulin cover by outdoor storage
- fire risk
- dimensions and weight of bales

Step 4: Critical Control Points

storage

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- checking moisture content in bales before loading for road transport
- measuring moisture content in bales
- storage facilities have a clean and concrete surface, which prevents entry of impurities or moisture from the “floor” as well as establishing of fungi or mould
- carry out visual inspection of bales
- contract between producer/supplier and customer with “terms of delivery” including fuel specifications

[a)] Weather conditions: If bales are left uncovered for too long during rainfall, the bales will take up too much water. No significant problems will occur during transport

[b)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

Step 6. Routines for separate handling of nonconforming materials and biofuels

If straw bales are not fulfilling the requirements as defined in the contract between producer/supplier and customer (e. g. moisture content, bale dimensions) these bales have to be separated from conforming bales, i. e. not loaded for road transport to end-user

If nonconformity is discovered at the premises of the consumer in connection with delivery, the bales will be rejected and must be taken back by the producer/supplier.

NOTE This example represents an individual plant or process. The document requirements vary depending on the situation and complexity of the process.

3.5 Olive residues

The first harvest of olives is possible about seven years after the planting of olive trees and takes place in Spain between mid-October and mid-March. 75 % of the harvested olives are transformed into waste material (kernels, leaves, brunches, olive cake etc.) after the oil-production and can be partly used as fuel.

High amounts of olives are plant and harvested in Spain, where no kind of standards or laws for olive residues combustion yet exists although olive residues are used as fuel for many years. The combustion takes place in small units (2-4 t fuel/a) as well as in large heating plants (>100.000 t fuel/a).

The smaller a combustion unit is, the better the fuel quality should be. In Spain the end user differs between olive kernels and olive residues. Olive residues contain skin, pulp and kernels and olive kernels are from the whole olive residues separated kernels.

Olive kernels can be combusted e. g. in adapted combustion units for wood chips but the olive residues can just be combusted in large power plants (higher ash-content, higher potassium content etc.). The fuel quality of pure kernels is better than of the whole olive cake.

In Spain no standards, labels, guidelines or certificates for olive-fuels exist, but the end users know by experience about the most important quality criteria, the moisture content and the pureness of kernels (no skin or pulp), to avoid combustion problems. Good indicators are the smell of the olive-residue-fuel. If the fuel smells like olives, the fuel contain also pulp and skin (olive cake), because pure olive kernels loos the smell after drying completely.

Too high content of moisture can cause problems during the combustion, so usually the small scale end user is storing the fuel after the heating period for the next period and the fuel can dry during the summer time. If an end user needs fuel immediately, the fuel can be wet, because of the missing drying time. Additionally the fuel can get wet because of fuel storage outside or transport in open trucks uncared of the weather.

Big scale users have large storing areas, so that they always store and let the material dry before combustion.

The most important influencing factor is the storage of fuel (effect on moisture content and on impurities), because the storage is normally not roofed and not concreted. The contamination of the fuel by earth or sand is possible because of the storage conditions and can cause problems like slagging during the combustion. Other influencing factors are origin and pureness of the olive fuel. Kernels are a better fuel than olive cake because of the lower moisture-, ash-, potassium- and halogens contents. The separation of pulp and skin from kernels is an additional processing step and implies additional amount of work. Olive kernels and olive residues are by products or waste products of the olive oil production, so the “fuel” quality for the oil producer is not important and they often do not take care of storage room, kernel pureness or avoiding of impurities.

Example of documenting requirements for the production of olive residues according to prEN 15234-1 - Fuel Quality Assurance – General Requirements

Production requirements according to prEN 15234-1 are subdivided into six consecutive steps.

Step 1: Fuel specification of the final product

Step 2: Production description (documentation of steps in the production chain)

Step 3: Quality influencing factors including company performance

Step 4: Critical Control Points for compliance with the fuel specification

Step 5: Measures to give confidence that the specification(s) is/are being realised

Step 6: Routines of separate handling of nonconforming materials and biofuels

The following information will give a general overview about documenting the requirements for the production in an olive residues / olive kernels supply chain.

Step 1. Fuel specification for the final product

The fuel specification is based on prEN 14961-1 general part, table 13 in case of individually met agreements. There is no product standard for olive residues at the moment.

Step 2. Production description (documentation of steps in the production chain)

The following flow sheet is a general example, which gives an overview about the whole supply chain for olive residues and olive kernels. Relevant single process steps in the supply chain are illustrated. In individual case the flow sheet for one single process step must be illustrated more detailed.

NOTE there is a big difference between the general fuel quality of olive residues like olive cake and pure olive kernels without pulp and skin, therefore both olive based fuels should be elaborated.

NOTE the illustration given is only a general example. The individual process chain might look differently at single process steps.

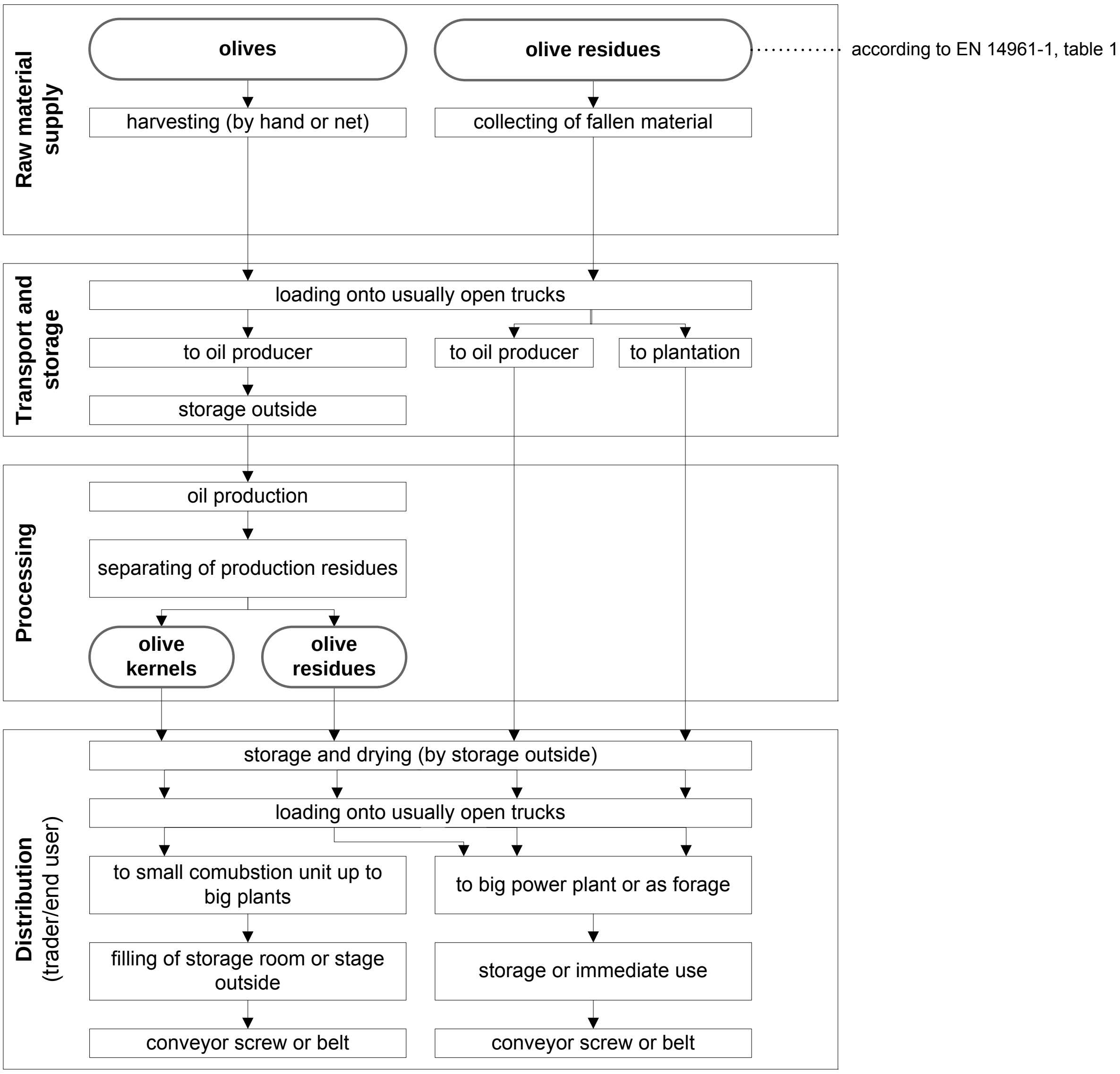
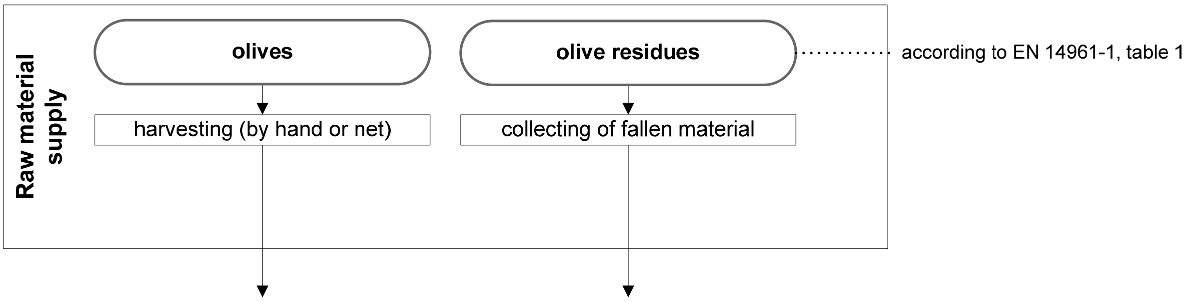


Figure 7 – An example of an olive residues / kernels supply chain

The following tables summarize steps two to five and give information about quality influencing factors (step 3), Critical Control Points (step 4) and appropriate quality measures (step 5) for each single process step (see figure 1).

Step 2: Production description – Raw material supply



Step 3: Quality influencing factors

- impurities [a)]

Step 4: Critical Control Points

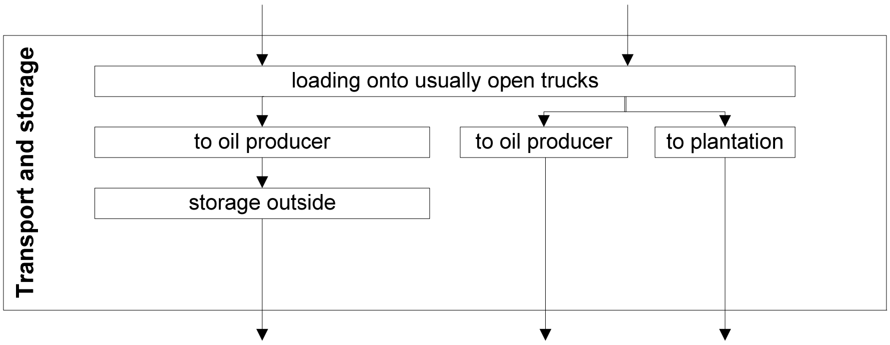
harvest of olives

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or other sensory inspections across the whole raw material supply process,
- avoidance of impurities like stones, soil, leaves entering the material during harvest
- agreements between supplier and customer about sort of biofuel: olive cake or pure olive kernels.

[a)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

Step 2: Production description – Transport and storage



Step 3: Quality influencing factors	Step 4: Critical Control Points
• impurities [a)] • weather conditions [b)] • storage time [c)]	storing of olives outside often unprotected
• cleanliness of transportation unit	transport of olives
• checking material quality	delivery of olives

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

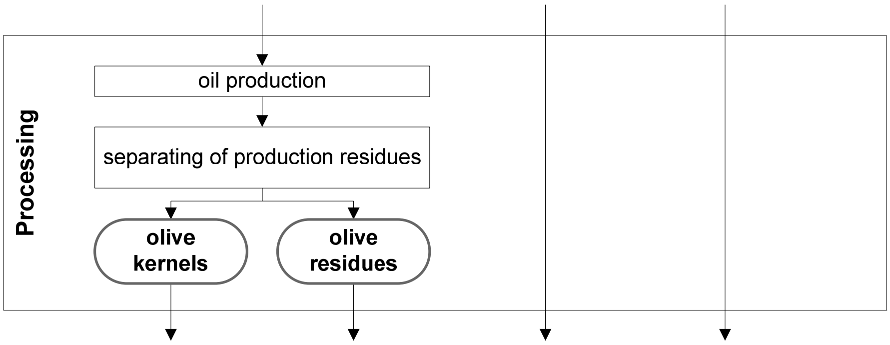
- carry out visual or other sensory inspections across the whole transport and storage process,
- storage areas have a clean and solid underground, which prevents an entry of impurities into the biofuel,
- transport equipment has to be free from impurities and has to protect the loading from rain or humidity,
- storage and transport equipment is checked regularly,
- agreements between supplier and customer with regard to biofuel sort (olive residues or kernels) and quality

[a)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

[b)] Weather conditions: Temperature and rain influencing drying of olive residues and kernels and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

[c)] Storage time: After oil production process olive residues are to wet for combustion and should be stored after harvesting time (~ March) during summer time to dry.

Step 2: Production description – Processing



Step 3: Quality influencing factors	**Step 4: Critical Control Points**
• impurities [a)] • weather conditions [b)] • storage time [c)]	oil production and storage of residues
• pureness of fuel	separation of production residues

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

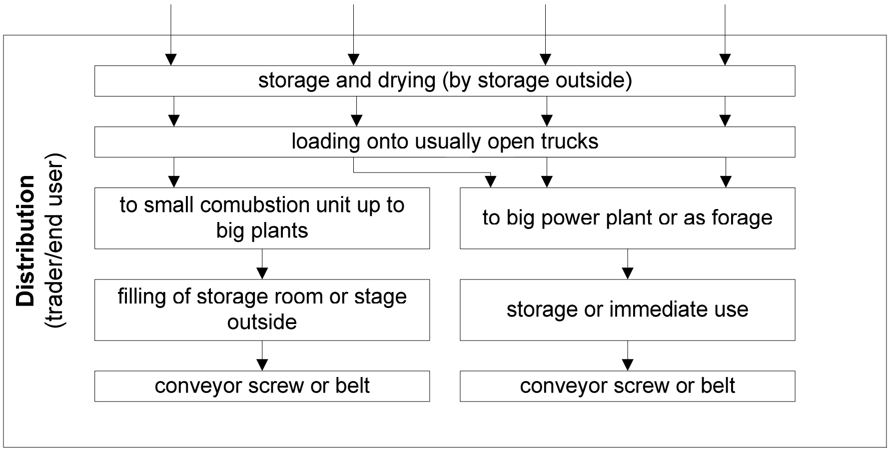
- carry out visual or with sensory inspections across the whole production process,
- agreements between supplier and customer with regard to biofuel handling and quality,

[a)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

[b)] Weather conditions: Temperature and rain influencing drying of olive residues and kernels and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

[c)] Storage time: After oil production process olive residues are to wet for combustion and should be stored after harvesting time (~ March) during summer time to dry.

Step 2: Production description – Distribution



Step 3: Quality influencing factors	Step 4: Critical Control Points
• impurities [a)] • weather conditions [b)] • storage time [c)]	storage and drying of fuel
• cleanliness of transportation unit	transport of olives
• checking material quality	delivery of olives

Step 5: Measures to give confidence to customers that the specification(s) is/are being realised

- carry out visual or with sensory inspections across the whole production process,
- storage areas have a clean and solid underground, which prevents an entry of impurities into the biofuel,
- transport equipment has to be free from impurities and has to protect the loading from rain or humidity,
- storage and transport equipment is checked regularly,
- agreements between supplier and customer with regard to biofuel sort (olive residues or kernels) and quality

[a)] Impurities: Material other than the fuel itself e.g. stones, soil, pieces of plastic, rope, ice and snow (see EN 14588)

[b)] Weather conditions: Temperature and rain influencing drying of olive residues and kernels and impurities like sand, stones etc., e. g. due to muddy underground after rain or humidity

[c)] Storage time: After oil production process olive residues are to wet for combustion and should be stored after harvesting time (~ march) during summer time to dry.

Step 6. Routines for separate handling of nonconforming materials and biofuels

If olive residues are not fulfilling the requirements, these batches have to be stored separately from conforming biofuel. All necessary information has to be filed. If nonconformity is discovered at the premises of the consumer in connection with delivery, a nonconformity report is generated and handling of the nonconforming lot is agreed with the consumer.

Signature of assigned person   Place and date

NOTE This example represents an individual plant or process. The document requirements vary depending on the situation and complexity of the process.

4 Literature

/1/ Bruins & Kwast, 2008

/2/ prCEN/TS 15234 Solid Biofuels – Fuel Quality Assurance, 2005

/3/ prEN 15234-1 Solid Biofuels – Fuel Quality Assurance, CEN TC 335 WG2 internal document, April 2009

/4/ Final Draft FprEN 14961 Solid Biofuels – Fuel Classification and Specification, CEN TC 335 WG2 internal document, April 2009

/5/ Langheinrich, Ch. et al.: Deliverable IV.2.D4 "GUIDELINE for development and implementation of Quality Assurance for solid biofuels". BIONORM-Project (ENK6-CT-2001-00556), WP 4 "Fuel Quality Assurance", Task 4.2 Implementation of Quality Assurance system; Field trials

/6/ Kaltschmitt, M.; Mohrig, V. et. Al: DIII.10 Procedure for Quality Improvement. BioNorm II "Pre-normative research on solid biofuels for improved European standards", Project no. 038644, 2009