DEVELOPMENT OF A TRACEABILITY PROCEDURE FOR BIOMASS ENERGY CHAIN

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ABSTRACT: Biomass Research Centre developed a methodology establishing criteria for planning and management of traceability of biomass supply chain for power plants. Traceability system regards all phases of energy chain from biomass production, meant as recovery of residual wood from industries, maintenance of forests and cultivation of energy crops, to fuel distribution and biomass storage at power plant. In the elaborated scheme, the entire documental system necessary to its application was defined through the predisposition of Supply Chain Management Handbook, suitable to describe the responsibilities and the management and to verify forms. Proceedings to comply with chain were defined for each kind of stakeholder. In order to make effective the traceability system, a control plan was prepared in which involved subjects, traceability components for each critical step of chain and document conservation managers were defined. Proceedings defined also the rules to make the biomass sampling both arriving at the power plant site and along the conveyor belt that feeds the boiler and the assessment operations of biomass quality, based on the most important physical-chemical parameters of fuel.
Keywords: certification issues, logistics, sampling, power generation.

1 INTRODUCTION

Biomass Research Centre developed three procedures for one of the most important Italian biomass power plant, establishing criteria for planning and management of biomass supply chain traceability. In the first document (*Biomass origin certification procedure*) the procedure for tracing wood biomass from field to power plant site was defined, in order to identify the different paths and possible intermediate processing. The second and the third procedures (*Incoming biomass sampling procedure* and *Biomass sampling on boiler feed line procedure*) included the rules to sample biomass arriving at the power plant site and along the line that feeds the boiler; these schemes allowed to obtain to the power plant company the guarantee of biomass quality.

The fulfillment of these procedures allowed to obtain some advantages, such as assurance of transparency and certainty criteria towards local community and competent Authorities.

Power plant analyzed was characterized by 20 MW electric power, employing an annual amount of biomass of 230.000-280.000 ton, constituted by dedicated energy crops, forest biomass, residual biomass from wood processing industries and chemical untreated waste wood.

2 BIOMASS ORIGIN CERTIFICATION PROCEDURE

Traceability system regards all phases of energy chain, from biomass production, meant as recovery of residual wood from industries, maintenance of forests and cultivation of energy crops, to fuel distribution and biomass storage at the power plant. The documental system necessary to the procedure application was defined through the predisposition of a Supply Chain Management Handbook, suitable to describe responsibilities and management and verify forms. The document was divided into sections, such as explained in the following paragraphs.

2.1 Biomass traced

The analyzed power plant employs the following kind of biomass:

- virgin biomass obtained from Short Rotation Forestry and from the cultivation of herbaceous biomasses;
- wood biomass from forest maintenance;
- residual biomass, chemical untreated, from wood processing industries;
- waste wood, chemical untreated, from storage centers, characterized by a specific EWC (European Waste Catalogue) code.

Each biomass supplier, at the time of contract signed, declares typology, nature (woody, herbaceous or fruit biomass), dimensions (logs, large pieces, chips) and physical-chemical properties (ash, ash fusibility temperature, moisture, lower heating value, nitrogen content, sulphur content and chlorine content) of biomass given, in the *Biomass Technical Sheet.*

2.2 Supply chain companies

Companies, belonging to the bioenergy chain, include the same power plant company, felling companies, farm companies, wood processing industries, storage centers, commercial biomass companies and biomass analysis laboratories.

All companies have to sign a supply contract, in which apply themselves to:

- adhere to Traceability Scheme and respect its rules;
- allow to power plant company to function as Chain Coordinator among the supply chain members;
- supply Chain Coordinator with requested data on traceability and quickly transmit possible non conformities found during biomass identification and registration;
- subject to controls established by Chain Coordinator.

In the supply contract, business name, address and the manager of each company are reported, with the name of Chain Coordinator company.

Companies belonging to the bioenergy chain are represented in the *Chain Flowchart* (Fig. 1).

2.3 Roles and responsibilities

For a correct planning and implementation of the Traceability Scheme, roles and responsibilities of involved functions have to define and formalize in the document *Job Description*, that comprises the following information:

- name of the Traceability Scheme Manager for each

company and its functions;
- operators employed in the Traceability Scheme for each company and their functions.

As an example, the functions of the Traceability Scheme Manager of the power plant company are:
- institution and maintenance of the Traceability Scheme;
- updating of the list of the companies belonging to the bioenergy chain;
- management and control of the traceability registration documents;
- maintenance of the relationships with the biomass suppliers regarding the traceability problems;
- planning the programs of the chain internal audits;
- implementation of the traceability procedures and their update;
- management of the non conformities in all parts of the chain and of the relative corrective actions;
- management of the internal audits execution.

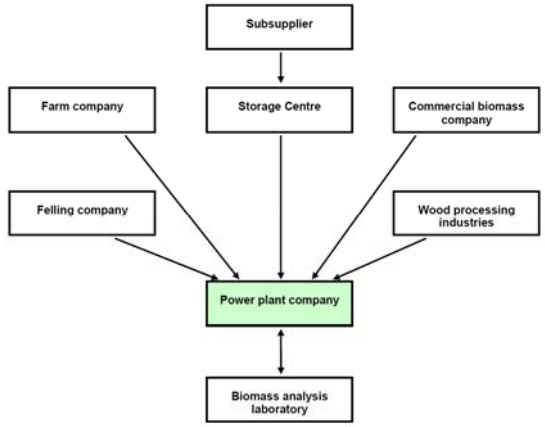

Figure 1: Chain Flowchart.

2.4 Lot definition

The lot concept is important to correctly and efficiently plan a traceability scheme. In general a lot is defined as the minimum unit, with homogeneous characteristics, produced and/or worked and/or packed in the same conditions or whatever equivalent in terms of species. In order to assure the traceability maintenance, it is necessary to define different lot types:
- *production lot*: a defined quantity of biomass produced in the same company, through the same technology process, characterized by the same nature and trade type and such as:
  - derives from the same biomass supply, in the case of wood processing industries;
  - derives from the same forest area, in the case of felling companies;
  - derives from the same dedicated energy crop, in the case of farm companies;

  each production lot will be identified by an alphanumerical code and will be accompanied by the *A-1 Sheet* (Fig. 2), declaring data congruent with the content of the *Biomass Technical Sheet*;
- *EWC-production lot*: a defined quantity of waste wood identified by an unique EWC code and delivered to a storage centre by a single subsupplier. Each production lot-EWC will be accompanied by a document defined in [1] and will be identified by an alphanumerical code;
- *storage lot*: a combination of some EWC-production lots, characterized by the same EWC code. EWC-production lots constituting each storage lot will be registered.

Sheet A-1

- Company
- Address
- Registration code to the traceability scheme
- Activity
  (forest management, cultivation of dedicated energy crops, wood processing, recovery of residual biomass, biomass trade)
- Operation
  (withdrawal/unload, date, code, biomass quantity)
- Delivered Lot Code

Figure 2: A-1 Sheet for production lot identification.

- *delivered lot*: it coincides with a single lorry arriving at power plant and it is identified with an alphanumerical code, attributed by the operator that carries out the visual inspection. A delivered lot has to be constituted by a single production lot. Each delivered lot is accompanied by *A-1 Sheet* and *A-2 Sheet* (Fig. 3), declaring data congruent with the content of the *Biomass Technical Sheet*.

Sheet A-2

- Production Lot Code
- Biomass nature
  (woody biomass, herbaceous biomass, fruit biomass, blend/mixture)
- Biomass dimension
  (logs, large pieces, chips)
- Production site
  (address, cadastral unit, area)
- Notes

Figure 3: A-2 Sheet for delivered lot identification.

- *EWC-delivered lot*: it coincides with a single lorry arriving at power plant from storage centers and it is identified with an alphanumerical code, attributed by the operator that carries out the visual inspection. A EWC-delivered lot has to be constituted by a single storage lot. Each delivered lot is accompanied by the document defined in [1], in which the alphanumerical codes of its EWC-production lots are registered.

2.5 Traced biomass identification

The biomass identification along the chain is realized accompanying lots, transferred among the operators, with their registration documents. The procedure that each supplier has to adopt to participate to bioenergy chain is explained in the following.
- *Felling company, Farm company, Wood processing industry*

  Each production lot has to be identified with the documents described in paragraph 2.4: if it is stored before the conferment to the power plant, it has to be

maintained separate from other production lots. Biomass delivery to the power plant is realized charging, in the same lorry, biomass belonging to a single production lot;

- *Storage centre*
  Each EWC-production lot has to be identified with the documentation described in paragraph 2.4. The next lot storage has to be realized mixing it with other production lots characterized by the same EWC code; production lots constituting each storage lot have to be registered. Biomass delivery to the power plant is realized charging in the same lorry biomass belonging to a single storage lot;
- *Commercial biomass company*
  Each delivered lot coincides with a production lot and it has to be identified with *A-1* and *A-2 sheets.*
- *Biomass analysis laboratory*
  Laboratory receives samples, identified with the abbreviation LAB, to analyze and, when results are obtained, it has to compile *SA 2* and *SC 2 sheets* (described in the following paragraphs), according to the sample type. Then Sheets have to be sent to power plant and storing the analyzed samples have to be stored for 4 months.

2.7 Traceability control plan

In order to maintain an efficient traceability system, it is necessary to arrange a *Control Plan*. In this document, the following information are reported:

- operators involved in the chain;
- critical steps of the chain for traceability scope;
- traceability elements to control, for each critical step (registrations, biomass identification, quantity and quality evaluation of biomass);
- manager of document registration and maintenance.

In particular for the company typologies belonging to the chain, the critical steps are the following:

- Felling company
  a. drawing up of the *A-2 Sheet* at the moment of forest area felling and belonging to a new production lot;
  b. registration, in the right documentation, of the surface of the forest area defined at point a;
  c. separate management of the delivered lots for power plant from those not belonging to the traceability system;
  d. drawing up, for each delivered lot sent to power plant, of the accompaniment documentation defined at paragraph 2.4;
  e. registration, in the right documentation, of the delivered lot weight sent to power plant.
- Storage Centre
  a. maintenance of the accompaniment documentation of EWC-production lots sent to storage centre by subsuppliers;
  b. correct management of EWC-production lots, according to paragraph 2.5;
  c. drawing up, for each EWC-delivered lot sent to power plant, of the accompaniment documentation defined at paragraph 2.4;
- Wood processing industry
  a. registration, in the right documentation, of the supply lots of purchased wood and representing new production lots. In particular, when company purchases a new production lot, the *A-2 Sheet* has to be filled out and delivered lots amounts, belonging to the same production lot, have to be registered;
  b. separate management of the delivered lots for power plant from those not belonging to the traceability system;
  c. control of the wood processing cycle which it has to be the same of that declared in the supply contract;
  d. drawing up, for each delivered lot sent to power plant, of the accompaniment documentation defined at paragraph 2.4;
  e. registration, in the right documentation, of the delivered lot weight sent to power plant;
- Farm company
  a. registration, in the right documentation, of the location and area of the fields used for the cultivation of dedicated energy crops;
  b. control of the growing techniques of energy crops;
  c. separate management of the delivered lots for power plant from those not belonging to the traceability system;
  d. drawing up, for each delivered lot sent to power plant, of the accompaniment documentation defined at paragraph 2.4;
  e. registration, in the right documentation, of the delivered lot weight sent to power plant;
- Commercial biomass company
  a. maintenance of the accompaniment documentation of production or delivered lots purchased according to paragraph 2.4;
  b. drawing up, for each delivered lot sent to power plant, of the accompaniment documentation defined at paragraph 2.4;
- Biomass analysis laboratory
  a. registration, in the right documentation, of the samples received from power plant;
  b. control of the adopted methodologies for the analysis;
  c. drawing up, for each sample received from power plant, of the *SA 2* and *SC 2 sheets*.

Every year each company has to sent to Chain Coordinator data regarding the evaluation of its input and output biomass quantities. Chain Coordinator has to control the received data congruity. Data sent to the power plant by each company are:

- Felling company
  a. forest area, belonging to the chain, subject to forest management;
  b. biomass quantity sold to Chain Coordinator;
- Farm company
  a. cultivated field area dedicated to biomass production and destined to Chain Coordinator;
  b. biomass quantity sold to Chain Coordinator;
- Wood processing industry
  a. purchased wood amount whose processing residues are destined to power plant;
  b. biomass quantity sold to Chain Coordinator;
- Biomass analysis laboratory
  a. number of analysis of samples sent by Chain Coordinator.

2.7 Non Conformities management

Non conformities are represented by handling errors, identification or registration losses that make not identifiable the biomass traced. In these cases, the not identifiable lot has to be excluded from traceability

scheme. In particular, non conformities can be found further to:

- control during biomass production phase;
- control during biomass storage;
- control during biomass transport;
- control during biomass acceptance by power plant operator. If it is possible the supplier has to send the accompaniment documentation of the relative delivered lot before arriving at Chain Coordinator; in this way non conformity can be solved before arriving at Chain Coordinator, allowing it to transfer to the next acceptance procedure step.

Non conformities have to be registered by the operator of the company that point out them in the *Non Conformity Report* document and subjected to the company manager for their resolution.

Lots not acceptable have to be identified and stored in a proper area.

Afterwards, non conformities have to be shared with Chain Coordinator, that verifies the adopted resolution effectiveness.

2.8 Internal Audits

Chain Coordinator plans and performs internal audits to verify the conformity of the activities to the scheduled requirements of traceability system. In particular, during internal audits, it is necessary to verify:

- that traced biomass are produced, stored and processed with a clear identification and are distinguishable from not traced biomass;
- correct drawing up of the registration documents;
- physical-chemical properties of traced biomass;
- correct management of noticed non conformities at companies.

Internal audits are planned by Chain Coordinator at the begin of the year, drawing up the document *Internal Audit Annual Plan*, in which dates for the companies controls are established. The minimum frequency of controls in each company is at least twice in a year.

3 INCOMING BIOMASS SAMPLING PROCEDURE

Procedure regards definition of the operations that the workers of the power plant company have to carry out to accept biomass of the delivered lot, verifying its quality through a visual inspection and physical-chemical analysis of some samples. In this step it has to be evaluated if biomass is effectively chemical untreated and if its quality fulfills the terms of signed contract. In particular two protocols were carried out, characterized by different guarantee levels towards the acceptance of biomass with suitable characteristics; in this paper the most restrictive procedure is described.

Sampling procedure was structured according to CEN/TS 14778-1 [2], CEN/TS 14778-2 [3] and CEN/TS 14779 [4] standards. In particular it was produced a scheme for each biomass trade type (logs, large pieces or chips), identifying two different procedures concerning manual or mechanical sampling.

In this paper, the procedure for wood chips and manual sampling was described; procedure steps were explained in the following, reporting, in round brackets, the abbreviation of the relative responsible operator:

1. (OAC) control of the accompaniment documentation of delivered lot. If there is a non conformity, transfer to the following step has not to allow, until the biomass path is verified; if it is not possible, the delivered lot has not to be accepted;
2. (OAC) visual inspection of biomass loaded in the lorry, taking two pictures relative to entire vision of lorry and only biomass loaded. If the operator finds just one non conformity, the discharge has not to be authorized. Non conformities are represented by:
   - presence of non homogeneous biomass, regarding trade type;
   - presence of foreign materials represented by every fraction of:
     a. plastic material;
     b. glass;
     c. rubber;
     d. solid fossil fuels;
     e. wood treated with glues, paints or other chemical substances.

   Checked non conformities have to be documented by a picture. If just one non conformity is found, the operator draws up the transport document, describing the found non conformities and issuing a copy to the lorry driver;
3. (OAC) weighting of delivered lot;
4. (OAC) arrangement of sampling reports, according to the models *SC 1A* and *SC 1B*;
5. (OAC) biomass dumping, in presence of driver, in the acceptance area of relative supplier, maintaining separate the delivered lot from others already present in this area. Visual inspection during and after biomass dumping, so to verify the absence of non conformities, taking a picture of heap formed;
6. (OAC) if just one non conformity is found, biomass has to be reloaded into the same lorry, proceeding as described in point 2;
7. (OAC) if non conformities are not found, the operator draws up the transport document, issuing a copy to the lorry driver;
8. (OBD) delivered lot, belonging to a production lot already present in the acceptance area of relative supplier, is stored for a maximum of three days with biomass of the same production lot; if biomass of the same production lot is not present, delivered lot is whatever maintained separate from biomass already present in the acceptance area;
9. (OAC) drawing up of the *SC 1B* report that contains:
   - code of sampling report;
   - codes of delivered lots belonging to the same production lot;
   - date and hour of each delivered lot arrival;

   report is closed when production lot is sampled;
10. (OAC) each biomass heap, relative to the same production lot, has to be subjected to a sampling after three days from the arrive of the first delivered lot, complying the following methodology [2].
    The operator has to divide visually the biomass heap in three parts (Fig. 4), taking from each layer a number of increments proportional to its volume. In each layer, sampling points has to be equally distributed. A skid steer loader can be used to move biomass and reach sampling points into the heap. Increments have to be taken at an height from soil equal at least to 300 mm.
    Each increment has to have a weight of about 1 kg. Increments are taken manually, employing metallic shovels characterized by a minimum volume of 3 liters. All increments are placed into the same

airtight container, not transparent, as plastic bucket with cover, forming a combined sample;

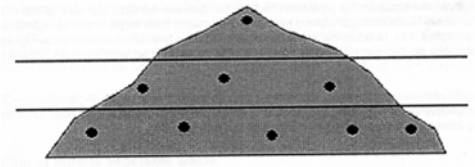

Figure 4: Example of sampling points in the biomass heap.

11. (OAC) drawing up of the *SC 1A* report (Section 1) that contains:
    - code of sampling report;
    - name of the operator of biomass sampling;
    - sampling location;
    - code of production lot;
    - type of vessel for sample conservation;
    - production lot supplier;
    - weight or volume of production lot;
    - number of increments;
    - weight of sampled biomass;
    - equipment for biomass sampling;
    - method for laboratory samples preparation.
12. (OAC) three laboratory samples, with a weight of 1 kg, have to be produced from the combined sample; samples are destined to the biomass analysis laboratory and to the supplier while the third is stored, for just 4 months, for possible controls by a third party organization. Methodology employed is quartering described in [5];
13. (OAC) laboratory samples are placed in airtight containers, not transparent, marked by identification code of *SC 1A* report and their destination (reporting the abbreviation LAB for the sample destined to biomass analysis laboratory, POW for the sample stored by the power plant company and FOR for the sample delivered to the supplier);
14. (MPL) the operator draws up of the *SC 1A* (Section 2) and sends the sample LAB to the biomass analysis laboratory, within 24 hours from the production of laboratory samples. *SC 1A* (Section 2) contains:
    - date of sample sending to the power plant laboratory;
    - biomass analysis laboratory;
    - date of sample sending to the biomass analysis laboratory.
15. (MPL) sample POW is stored for 4 months in a cool and dry place, then, if the sample belongs to a conforming lot, it can be send to the boiler;
16. (MAL) the operator has to analyze the following physical-chemical parameters:
    - moisture;
    - ash content;
    - fusibility ash temperature;
    - carbon, hydrogen, nitrogen content;
    - lower heating value;
    - sulphur and chlorine content;
    - minor and major elements content (Al, Ca, Fe, K, Mg ,Na, P, Si, Ti, As, Cd, Cr, Cu, Hg, Ni, Pb, V e Zn);
17. (MAL) drawing up of the *SC 2* report, verifying the production lot conformity through the comparison between the values obtained from the analysis and those reported in the *Biomass Technical Sheet* of the relative supplier (for the parameters: moisture, ash content, fusibility ash temperature, nitrogen content, lower heating value, sulphur and chlorine content) and in the *Wood Biomass Properties* document (for the other parameters) (Fig. 5).

Parameter	*Unit of measurement*	*Limit value*
Ash content	% w/w d	< 5
Fusibility ash temperature	° C	> 1100
Moisture	% w/w ar	< 45 (in summer) < 48 (in winter)
Lower heating value	MJ/kg ar	8.6 – 13.4
Carbon	% w/w daf	47 – 54
Hydrogen	% w/w daf	5.6 – 7
Oxygen	% w/w daf	40 – 46
Nitrogen	% w/w daf	< 0.5
Sulphur	% w/w daf	< 0.1
Chlorine	% w/w daf	< 0.04
Aluminium	mg/kg d	< 1000
Calcium	mg/kg d	< 20000
Iron	mg/kg d	< 600
Potassium	mg/kg d	< 4600
Magnesium	mg/kg d	< 2000
Sodium	mg/kg d	< 450
Phosphorus	mg/kg d	< 1300
Silicon	mg/kg d	< 10000
Titanium	mg/kg d	< 50
Arsenic	mg/kg d	< 2
Cadmium	mg/kg d	< 1
Chromium	mg/kg d	< 10
Copper	mg/kg d	< 10
Mercury	mg/kg d	< 0.05
Nickel	mg/kg d	< 10
Lead	mg/kg d	< 10
Vanadium	mg/kg d	< 2
Zinc	mg/kg d	< 100

Figure 5: Wood Biomass Properties document (d: dry basis, ar: as received basis, daf: dry and ash free basis).

If the values are into the established limits, unless for the measuring errors, the production lot is evaluated conform. SC 2 report contains:
- date of sample arrival to the biomass analysis laboratory;
- code of sampling report;
- parameters analyzed;
- reference standards;
- analysis results;
- limit values;
- weight of sample used for the analysis;
- declaration of lot conformity/non conformity.

18. (OBD) biomass belonging to a conforming production lot is moved from the acceptance area to the feeding area;
19. (OBD) biomass belonging to a non conforming production lot is moved from the acceptance area to the withdraw area and it has to be withdraw by the relative supplier within 2 days from the communication of the non conformity.

4 BIOMASS SAMPLING ON BOILER FEED LINE PROCEDURE

This procedure regards the definition of the

operations necessary to sample biomass on boiler feed line, so to verify the quality of the biomass mixture with respect to plant performances. Also in this case two versions of the procedure were carried out, regarding manual or mechanical sampling; in this paper the first type is described, in which sampling is carried out from falling stream.

1. (OBD) arrangement of *SA 1* report that contains four sections (A, B, C and D):
   Section A:
   - sampling date;
   - code of sampling report;
   - sampling location;
   - equipment for biomass sampling;
   - type of vessel for sample conservation;

   Section B:
   - identification number of sampled increment;
   - hour of increment sampling;
   - weight of sampled increment;

   Section C:
   - total weight of sampled biomass;
   - method for laboratory samples preparation;
   - notes;

   Section D:
   - date of sample sending to the power plant laboratory;
   - biomass analysis laboratory;
   - date of sample sending to the biomass analysis laboratory;

   Section B has to be progressively drawn up, every three hours up to obtain four increments, by the operators responsible of biomass movement. The first operator draws up Section A and the last operator Section C;
2. (OBD) the operator responsible of the first sampling carries out sampling, adopting the following methodology [4]: a sampling box has to be used passing it through the stream of falling biomass so that it cuts the whole of the falling stream. The width of the opening of the sampling box (b) has to be at least 2,5 times the nominal top size (d) of the biomass to be sampled. The box shall be large enough so that it does not become overloaded. The velocity at which the box is passed through the falling stream shall be uniform and shall exceed neither 1,5 m/s nor [0,3+0,1x(b/d)] m/s.
   Sampled biomass has to be placed into an airtight container, not transparent;
3. (OBD) the operators responsible of the next two samplings (adopting the same procedure described at the point 2) place the increments into the same container of the first one;
4. (OBD) the operator of the fourth sampling produces laboratory samples adopting the quartering procedure [5]; two laboratory samples, with a weight of 1 kg, have to be produced from the combined sample, obtained mixing the four increments; samples are destined to the biomass analysis laboratory and for possible controls for at least 4 months;
5. (OBD) two laboratory samples are placed in airtight containers, not transparent, marked by identification code of *SA 1* report and their destination (reporting the abbreviation LAB for the sample destined to biomass analysis laboratory and POW for the sample stored by the power plant company); LAB and POW are immediately sent to analysis laboratory of power plant company;
6. (MPL) the operator draws up of the *SA 1* report (section D) and sends LAB sample to the biomass analysis laboratory within 24 hours from its reception;
7. (MPL) POW sample is stored for 4 months in a cool and dry place, then, if it is conform, it can be sent to the boiler;
8. (MAL) the operator has to analyze the following physical-chemical parameters:
   - moisture;
   - ash content;
   - fusibility ash temperature;
   - nitrogen content;
   - lower heating value;
   - sulphur and chlorine content;
9. (MAL, MPL) drawing up the *SA 2* report (characterized by the same format of the *SC 2* report), verifying the sample conformity, through the comparison between the values obtained from the analysis and those reported in *Wood Biomass Properties* document. If the values are corresponding, unless for the measuring errors, sample is evaluated conform, otherwise power plant company manger has to be informed.

5 CONCLUSIONS

Biomass Research Centre developed a methodology establishing criteria for planning and management of traceability of biomass supply chain for power plants. Procedure is divided in three parts respectively regarding: the biomass identification along the chain till arriving at the power plant company, through the different operators adhering to traceability scheme; the biomass sampling at the entrance of power plant so to establish the conformity of the supplied material; the biomass sampling along the boiler feeding line.

The first scheme is important mainly to guarantee that power plant company knows the purchased biomass origin and its processing practices; in this way it can be obtained more easily authorizations for the realization of a bioenergy chain. In order to make successful the traceability scheme, the concept of lot was introduced, defined as the smallest unit, with homogeneous properties, produced or processed in the same conditions. In particular biomass identification inside the chain was realized accompanying the lots, transferred through the different stakeholders, with their registration documents.

The second scheme defines a sampling procedure, according to the reference standards, for the biomass acceptance; procedure can be considered preventive towards non conforming biomass sending to boiler because all delivered lots are analyzed. Limits of this scheme are mostly referable to the statistical significance of the biomass sample. In particular, procedure permits to control not only the effective biomass virginity but also its energetic properties so to verify data reported by each supplier in the contract signed.

Finally the third procedure is important because, generally, mixtures of different types of biomass are sent to the boiler; therefore it is necessary to sample biomass along feeding line so to understand if the biomass blend produced is acceptable for the correct functioning of boiler.

The entire scheme could be improved planning the

displacement of delivered lots in the feeding area, maintaining them distinct for production lot and supplier. In this way biomass traceability could be also obtained inside the power plant; therefore if emission limits were exceeded, it would be possible to trace the production lot that caused the exceeding and its supplier.

6 NOMENCLATURE

EWC	European Waste Catalogue
MAL	Manager of biomass Analysis Laboratory
MPL	Manager of the power Plant Laboratory
OAC	Operator of power plant company employed in the biomass Acceptance and Classification
OBD	Operator of power plant company employed in the Biomass Displacement

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