



Guideline for safe and eco-friendly biomass gasification

Minutes of the joint European Workshop

On the Way to safe and eco-friendly Biomass Gasification

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1 Introduction

Biomass gasification is considered a promising technology that can contribute significantly to renewable energy generation. Leading gasification experts joined in the EU and IEA Gasification Network recognised Health, Safety and Environmental (HSE) issues as an important barrier in the deployment of this technology. The technology is close to commercialisation but large-scale implementation is hampered by the poor awareness and lack of understanding of Health, Safety and Environment issues; authorities tend to impose unrealistic and costly requirements on gasification plants.

The HSE aspects of biomass gasification were discussed in several workshops of IEA Biomass Gasification (Task 33) and the European network ThermalNet. The conclusion of these workshops were that these unsatisfying conditions represent a barrier, which have to be overcome by initiating and supporting the development of a guideline and harmonization action at a European level. A broadly accepted HSE guideline would effectively tackle the barrier. Out of these activities resulted the project «Guideline for safe and eco-friendly biomass gasification», which is co-funded by the European Commission.

The main objective of the project is to accelerate the market uptake of biomass gasification technology by developing a guideline that is accepted by relevant target groups and key market actors. The HSE project will result in a Guideline and a Software Tool for easy and systematic assessment of HSE hazards in biomass gasification plants. This can be used in designing more safe and eco-friendly equipment, in the construction of plants, and in the operation and maintenance procedures.

A draft version of the Guideline and Software Tool is now ready (interim period of the project) and can be obtained through the website www.gasification-guide.eu. The whole process chain of a gasification plant has been considered in the risk assessment, the main potential Health & Safety hazards are illustrated in Figure 1.

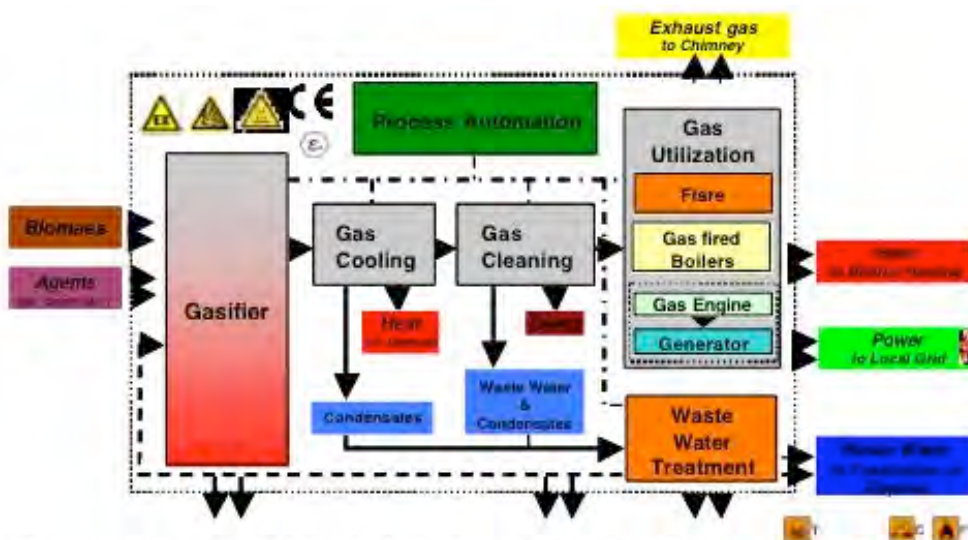


Figure 1: Potential Health & Safety hazards of Biomass Gasification plants

During the Gasification Guide project, two European workshops are planned. The first workshop was held on 23th April 2008 in Vienna as a joint workshop of the Gasification Guide project, IEA Biomass Gasification (Task 33) and ThermalNet. During this workshop, the collected and verified information of the first interim period of the project was presented to all target groups and others who are interested in the subject. During the workshop the audience was informed about the identification and definition of all existing hazards as well as the legal framework of biomass gasification. However, the main focus was on the draft Guideline, which was completed a few days before the workshop. The audience got the opportunity to review the collected information including those obtained from the plant owner and/or manufacturer within four case studies. The draft Guideline contained several controversial statements and recommendations on safety aspects and risk reduction measures. The project team aims for a consensus on all those controversial items and the feedback from the audience on these aspects could be a useful tool to get those issues clarified.

2 Workshop programme and attendees

In the morning session, the focus was on presenting the draft Guideline, while the afternoon session was dedicated to two panel discussions. The agenda is attached in Annex A. Over 500 persons were invited to the event and 65 people from 20 nationalities attended the workshop, see Annex B. Their background categorised to target groups are listed below:

- Industry: 17
- Designers, Consultants, etc.; - 4 of them from big energy suppliers
- Universities: 19 – 5 of them PhD or diploma Students
- Researchers: 21
- Public bodies: 6 – EU Commission, authorities, etc.

All presentations are available from the project website www.gasification-guide.eu

3 Overview of presentations

3.1 Introduction and History

The HSE subject is already on the agenda of international networks since early 2000. This back-up support from recognised international experts in biomass gasification was an important reason to the EC to support this project financially. The idea behind the project, the history, the importance and the objective were presented by Mr. Ruedi Bühler from Switzerland, member of the IEA Bioenergy Task 33 on Biomass Gasification and the European ThermalNet project. The presentation showed the many different activities already conducted and the importance of tackling the non-technical obstacle by a common effort of partners and the international support of recognized networks. One of the comments was on the lack of awareness of HSE related safety issues: it should be emphasized that although this is an important barrier for the deployment of biomass gasification, it should not be generalized to all target groups and all manufacturers in particular.

3.2 Project Overview

Mr. Harrie Knoef, BTG presented an overview of the project explaining the work packages and approach. An important support to the project team is the external Advisory Group, which contains over 20 international experts from all over the world. The presentation included some major and remarkable results from the case studies and the main dissemination activities completed so far. The project is on schedule and no delays are expected to happen in the remaining period of the project.

3.3 Overview Draft Guideline

The main part of the draft Guideline was presented by Mr. Harrie Knoef of BTG. Focus was on the information needs for the different target groups (what should they ask for and from whom) as well as the potential hazards and good design principles in practice. The presentation included some controversial statements which were discussed by the audience. It was clear that also the audience had several different views on safety related issues and measures. It was suggested to take advantage of HSE issues developed in other proven technologies like combustion, the chemical industry, refineries, etc. In particular on the fuel storage, handling, transport and feeding, important work has been completed in biomass combustion facilities which could possibly be applied to biomass gasification as well as this plant section does not significant differ from each other.

3.4 Legal Framework

The results of Legal Framework for Biomass Gasification in Europe was presented by Mr. Ulrich Seifert, Fraunhofer Umsicht. The main findings are described in Chapter 3 of the draft Guideline document. The results show the large difference between the different European states on the Legal Frame and the different way how European Directives have been transposed into national legislation. This makes a general overview quite complex and supports the idea that some harmonisation is recommended to accelerate the market introduction of new technology.

The presentation also included crucial statements whether or not ATEX, PID, Declaration of Conformity, etc. are valid to biomass gasification, and if BAT (Best Available Technologies) does exist in case of small scale biomass gasification. From the discussions, it became clear that this remains difficult as the directives can be interpreted differently.

It was suggested that controversial issues should be clarified between for instance PED experts and explosion experts at the European level. Further actions will be formulated regarding recommendations for harmonisation of the legal framework. As an example, the favourable emission limits introduced in Denmark for biomass gasification were mentioned as a good example to promote gasification. On the contrary, the audience criticized favourable emission limits for one technology over the other. This discussion will be continued in the coming period and hopefully a recommendation can be given in the final guideline based on a consensus.

3.4 Risk Assessment and Software Tool

Mr. Helmut Timmerer, TU Graz presented the systematic approach within the risk assessment used in the project. Risk Assessments are essential to put products on the market and is therefore an important task in the project. There are several methods used in practice and one particular method was found most suitable for biomass gasification.

Within this specific task also a Software Tool was developed called “Risk Analyser” which is a tool to make a in-depth risk assessment for a specific design or installation and by means of taking specific safety measures the tool can be used to design and construct a HSE safe biomass gasification plant. A draft version is ready and being tested by project partners.

3.5 Good Design Practice

Next to the identification of potential safety issues in practice and how to deal with risk assessment, an important part of the Guideline is addressed to good design and operation of gasification plants in practice. The overview was presented by Mr. Jens Dall Bentzen on behalf of COWI. COWI has completed several HAZOP studies on gasification plants in Denmark and the good design practice is in particularly based on this experience. The good design practice is provided on several aspects like for the process equipment, plant in general, construction and building, shielding, operation and maintenance, general safety procedures and some other supplementary precautions to be considered. The presentation also included the necessary plant documentation and outline of the content.

3.6 French experience on good design practice

An interesting presentation was made by Mr. Nicolas Millet, biomass development manager at Eneria, the French distributor of Caterpillar gas engines. Eneria is involved in a French gasification project of 1 Mwe, which incorporates a PRM updraft gasifier, the OLGA tar removal technology and a Caterpillar gas engine. The focus was on safety aspects of the gasifier only, since the operating experience with the other sections are very rare up to now.

The permitting took a very long time (2 years) and authorities prefer to say NO instead of YES because they had no experience with the technology and the regulations. Mr. Millet explained the control strategy applied, the sensors and alarms installed, security measures taken and hazardous areas around the plant. It was concluded that a Guideline on HSE safety issues would be a great aid to shorten procedures and get installation approved to place on the market.

3.7 Annotations to the Guideline

Mr. Thomas Otto presented his comments from the point of view of an engineering company on the draft Guideline. The „basic“ dangers are the normal ones (“the term „hazard“ seems a little bit too strong to me to describe the situation”):

- finger cutting
- squeezing
- breaking legs
- bumping the head

and a lot of electrical causes for dangerous situations.

The gasifier plant consists of several components fulfilling each one function and these components are all together ONE machine. So, even small plants have to deal with the Machinery Directive, according to Mr. Otto, the foundation of the Gasification Guide should be the Machinery Directive. On a more general level, the Product Liability Directive 85/374/EEC applies to all products. The properties of the machine determine what other EU-Directives around the Machinery Directive apply like: 98/24, 89/391, 2004/108, 2006/95, 94/9, 97/23, 87/404.

Reference can be made to several normative standards like:

- EN 1050 (new EN ISO 14121-1) This part of ISO 14121 gives practical guidance on the conducting of risk assessments for machinery in accordance with ISO 14121-1 and describes various methods and tools for each step in the process. It also provides practical guidance on risk reduction (in accordance with ISO 12100) for machinery, giving additional guidance on the selection of appropriate protective measures for achieving safety
- EN ISO 12100. Safety of machinery. Basic concepts, general principles for design. Technical principles. EN ISO 12100 is a two-part standard key to designers of machinery:
 - BS EN ISO 12100-1:2003 Safety of machinery. Basic terminology and methodology
 - BS EN ISO 12100-2:2003 Safety of machinery. Technical principles
- EN ISO 13849 Safety of machinery -- Safety-related parts of control systems. Part 1: General principles for design. Part 2: Validation
- and so on.

Appendix A of EN ISO 1050 deals at point 7 with dangerous substances like flammable gases and dusts. At this point we enter the area of Explosion Protection, ATEX Directive 94/9. If gasification plants are designed in the sense of the ATEX Directive to create "Inherent Safety", Ex-zoning will not be necessary. This can be achieved by good teamwork between the process engineer, the designer of the construction and the specialist for explosion protection. Ex-zoning makes problems and costs for SME companies who are active in putting installations on the market, so this may be contra-productive.

Mr. Otto emphasized that methods for risk management and the description of possible hazards are necessary parts of the guide, but it should be done in a manner, so that one does not assume that explosions and extreme hazards are characteristic for small and medium gasification plants.

4. Panel discussions

4.1 *Reflection on safety issues from the practice*

Mr. Suresh Babu, Task leader of IEA Bioenergy Task 33 on Biomass Gasification moderated the first panel discussion and invited experts around the audience to reflect on the Guideline by presenting safety related issues in practice from their institutes and their experience.

Mr. Lars Waldheim from TPS, Sweden emphasized the risks associated with gas coolers and suggested to consider to include safety integrity levels in the control system. He also mentioned that the IPPC is being updated which might influence the discussion on safety issues and emission limits. He is not in favor of special emission regulations for each individual technology.

Mr. Richard Bain, NREL, USA explained that there are three levels of regulations in the USA. He emphasized that plant need to be insured which has consequences for manufacturers and plant owners to consider HSE issues carefully. He suggested to express emission limits in amount per energy produced, which makes a reference to the oxygen level redundant. In the USA, the focus is on gasification of agricultural residues which contain higher levels of nitrogen and sulphur. This will have an impact on the emission which must therefore closely considered in the technology development.

Mr. Calvin Feik, NREL, USA give an overview of HSE safety measures taken in the National Bioenergy Centre Laboratoria at NREL. These are most stringent and meet very strict regulations like leakage alarm systems, safety control systems, shutdown procedures, detectors, etc. NREL has an own HSE department who assist in putting the procedures in place when a new pilot plant is being constructed and operated in the laboratories.

Finally, Mr. Suresh Babu expressed again the importance of the HSE project; at least one important objective has been achieved, which is raising awareness among the target groups on the importance of this subject. More lessons could be learned from well organised laboratories like at NREL of the chemical industry.

Some participants expressed the fear that a Guideline pre-scribing what needs to be done on HSE safety measures will increase the plant capital costs. This may be true or not, but there was a general consensus that safety is more important. Moreover, the financial viability depends not only on capital costs but also (and perhaps even more) on fuel prices (increasing) and feed-in tariffs, which differ largely between countries. Mr. Suresh expressed that a good balance should be aimed for between economics and security.

4.2 Reflection on safety issues from the practice

Mr. Ruedi Bühler, Switzerland moderated the second panel discussion and invited project partners around the table to answer questions, remarks and suggestions of the audience on several controversial statements derived from the draft Guideline. The first question whether a Declaration of Conformity (DoC) relating to the entire gasification plant is needed (in addition to DoCs for functional units) initiated a large discussion from the beginning. The allocation of responsibility for plant safety to the manufacturer or to the owner/operator turned out to be a key aspect. (In case of an accident due to technical causes in a plant where major alterations have been carried out by the plant owner/operator, it may be a matter in dispute whether the manufacturer can still be held responsible for that accident. At the present stage of BGP development, plant modifications performed by the owners/operators after commissioning of the plant are quite common.) For time constraints the discussion had to be ended without consensus.

Regarding emission limits an important question raised was which emissions are harmful or not. CO was not considered to be a harmful emission from the engine exhaust.

Whether or not we need to use "ex-proof" equipment should depend on the results from a hazard analysis and risk assessment and not on the number of incidents reported so far or on the price of equipment. Explosions are rare incidents in general, and it is likely that you can even operate non-suitable equipment (e.g. normal asynchronous electrical engines) in hazardous explosive atmospheres for quite some time before the first explosion will occur.

It has been suggested to prevent ex-zones as far as possible by proper plant design, in particular by avoiding potential leaks and by ensuring proper ventilation.

Backfiring is a serious hazardous problem and flame arrestors are only recommended at places where tar deposits are almost not possible like after the gas-air mixer of the gas engine.

Due to the intensive discussions, not all controversial statements could be reviewed, this needs therefore to be discussed in the coming period by other communication means between experts.

4.3 Concluding remarks and closing

Mr. Knoef presented a few slides summarizing the workshop presentations and discussions. The presentations and draft guideline will be made available on the website as soon as possible by BTG. He emphasized the need to get serious feedback on the document in order to reach consensus on controversial issues and to prepare a final Guideline which is the ultimate goal of the project. To reach a consensus is the main challenging work to be done in the second part of the project. All target groups will be invited to use the Guideline and asked for feedback; only in this way, a approved final Guideline can be published.

The workshop was successful with almost 70 participants and in particular thanks was given to Mr. Michael Fuchs of TU Vienna who organised the workshop.

Prof. Hermann Hofbauer expressed his thanks on behalf of TU Vienna to the organizers, the project team and the audience coming to Vienna and closed the workshop inviting all participants to the second workshop next year.

HSE Workshop agenda



“On the Way to safe and eco-friendly Biomass Gasification”

Wednesday, 23rd April 2008

Vienna, Austria

Time	Topic	Title	Speaker
08:30	Registration	-	-
09:00	Opening and Welcome	-	Hermann Hofbauer Michael Fuchs, University of Technology Vienna
09:05	Introduction and history	-	Ruedi Bühler, Umwelt + Energie
09:15	Presentation	HSE project	Harrie Knoef, BTG
09:45	Draft Guideline	Overview (Target, Structure, Content)	Harrie Knoef, BTG
10:15	Coffee Break	-	-
10:45	Draft Guideline	Legal framework	Ulrich Seifert, Fraunhofer UMSICHT
11:30	Draft Guideline	Risk assessment and software tool	Helmut Timmerer, TU Graz
12:15	Draft Guideline	Good design practice	Jens Dall Bentzen, COWI
12:45	Lunch buffet	-	-
14:00	Keynote Speaker	Good design practice (HSE) in France	Nicolas Millet, ENERIA
14:15	Reflection on the Guideline	Engineer/Advisor	Thomas Otto, FEE
14:45	Panel discussion	“On the Way to safe and eco-friendly Biomass Gasification”	Moderation: Suresh Babu, IEA Ruedi Bühler, Umwelt+Energie
16:00	Coffee break	-	-
16:30	Panel discussion	“On the Way to safe and eco-friendly Biomass Gasification”	Moderation: Suresh Babu, IEA Ruedi Bühler, Umwelt+Energie
17:30	Summary		Harrie Knoef. BTG
18:00	Closure of the workshop		Hermann Hofbauer, University of Technology Vienna

Chairman: Hermann Hofbauer, University of Technology Vienna

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