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Development trends in utilisation of solid biofuels

Bioenergy media represent comparatively cheap fuels which make them economically attractive for central-heating plants, sometimes even without specific financial support. Acceptable biofuels in this sense can be tree cuttings, thinnings and fallen wood and agricultural by-products such as straw and reject grain. Also acceptable are process residues from mills or biogas plants as well as specially produced bioenergy crops (energy grain/cereal wholecrop, miscanthus, short-rotation coppiced poplar and willow).

Regenerative raw material is as bioenergy medium regionally and sustainably available in rural areas and with outstanding production and utilisation potential. Uses include production of heat, joint heat and electricity, or for fuel. It's now regarded as an important sector of the economy.

Regulatory approval

The first Federal Emission Protection Provision (1st BlmSchV) listed energy-producing fuels permitted for small heating plants including various wood-based fuels and "straw and similar plant materials". BlmSchV explanations cite, e.g., elephant grass, reeds, hay and maize cobs as straw-similar energy plants. Thus stalk-based fuels such as miscanthus, chopped straw or straw pellets are accepted for approval-exempt 15 to 100 kW boiler plants under the 1st BlmSchV with regard to the 4th BlmSchV. But grain, according to the 1st BlmSchV explanations, is not explicitly listed, and therefore not approved, as energy fuel. In the meantime several states have given exceptional approval for heating with grain under, in part, intensified emission thresholds and requirements on source and type of grain.

In boilers with nominated performances over 1000 kW, grain and stalk material may be used as fuel. For these mandatory approval plants, a complicated permission procedure under 4th BlmSchV and §19 BlmSchG (Federal Emission Protection Law) is required (in the case of wood fuel, from a boiler heat production of 1 MW). Hereby the TA-Luft (Technical Manual Air Purification Standards) must be proved to have been fol-

lowed, as required for wood for fuelling boilers with an output over 1 MW (Table 1).

There is need for urgent regulation here to establish secure legality for alternative solid biofuels in boiler plants. In the relevant provisions, alternative solid biofuels were meant to be accepted as energy fuels and established with fixed technical and economically realisable emission thresholds.

With the renewal of the 1st BlmSchV expected in 2007, exhaust emission thresholds will probably be intensified and possibly linked to the threshold values of the TA-Luft. For keeping under future emission threshold values, considerable efforts will be required in the further technical development of such plants.

FNR targets for energy production from grain and other bioenergy media

With comprehensive project support for alternative bioenergy media, the FNR (Agency of Renewable Resources in Germany) aims to enable acceptance of grain and other solid biofuels as energy fuels in the 1st BlmSchV. Requirements hereto are:

- Further development of present technologies, and
- proof of suitability for approval of appropriate plants, even with future tightening of present legal requirements.

Hereby greater use of available raw material potential and additional value-adding opportunities in rural areas should be aimed for, bearing in mind climate protection targets and bioenergy strategy.

Since 2004 the FNR has accordingly supported 10 solid bioenergy media projects

Table 1: Applicable regulations for certification of biofuel-fired boiler plants.

Combustion heat production	Wood	Straw and stalks	Grain
Up to 15* kW	1st BlmSchV	1st BlmSchV	1st BlmSchV
15 to 100 kW	1st BlmSchV	Operation forbidden 1st BlmSchV	Operation forbidden
100 kW to 1 MW	1st BlmSchV	4th BlmSchV with TA Luft	Operation only with special permission 4th BlmSchV with TA Luft
Over 1 MW	4th BlmSchV with TA Luft	4th BlmSchV with TA Luft	4th BlmSchV with TA Luft
* Nominal heat production			

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Keywords

Biofuels, regulatory approval



Fig. 1: Fuel burns almost completely in the biomass boiler. Ash proportion is around 1%.

with a total 2 million €. The research target of these schemes can be defined as follows:

1. Testing that biomass boilers, including those using grain as fuel and already warranted by their manufacturers for the use with these alternative biofuels, are suitable for official approval under the present law;
 2. Updating present technical standard towards improvement of boiler plants and clear reduction of exhaust emissions through primary (burning techniques) and secondary (plant independent) measures.
- With the 10 projects FNR aims to demonstrate that whole plants or grain can also be used for heat production in an environmentally safe way.

The interim results from the research projects make it clear that the use of grain and other biofuels for energy production in small boiler plants is technically feasible. Field tests with selected boilers prove there is no fundamental problem in keeping below present 1st BlmSchV threshold values, even with grain or straw pellets. In fact dust and carbon monoxide emissions with some plants are well under the limits. In particular, modern plants that have been especially developed for the burning of grain and straw

pellets have CO and dust emissions well below present 1st BlmSchV limits. However, NOx emissions could create problems regarding the respective limitation probably expected in the renewed 1st BlmSchV. First orientation measurements of potentially polluting emissions (e.g. PAH and PCDD/F) from small boiler plants with grain as fuel indicate that the presently applicable thresholds of the TA-Luft for plants considered suitable for approval under the 4th BlmSchV could be met.

The work of the Institute of Energetic and Environment GmbH can be included in the present search for alternative biofuels: this looks at straw burning in plants of medium output between 100 and 1000 kW. Since January practical and environmentally-acceptable ways of using loose or baled straw as fuel in plants with less than 1 MW output have investigated. A total straw as rural energy medium concept is expected to be presented by the end of 2007. Contrary to other projects the explicit target here is to identify boiler systems for baled or loose straw that are suitable for official approval and can therefore be constructed and marketed. This offers good opportunities for agriculture in the economically and ecologically viable self-use for what is, after all, a very plentiful material.

Graduated scheme for acceptance of grain in the 1st BlmSchV

In the seminar "Exploitation of grain and alternative biofuels for energy production in small boilers", May 11, 2006 in Berlin the research and development results mentioned here were presented and discussed. In that

Table 2: Graduated scheme for consideration of grain and biofuels in plants under the 1st BlmSchV with supplementation from §3, regular fuels and §6, threshold values for exhaust gas emissions, appendix III, Nr. 2

Time window	Stage	Threshold CO (presently 2 / 4** g/Nm ³)	Threshold Dust (presently 150 mg/Nm ³)	Target value NOx (presently no limitation)
		mg/Nm ³ based on 13% remaining O ₂		
Immediately*	1st	2*	130*	1000*
From 2010	2nd	1	100	800
From 2015	3rd	0,6***	75***	600***

* Action: Acceptance of grain and cereal wholecrop as energy fuel according to §3, 1st Federal Emission Protection Provision (1st BlmSchV) performance-independent threshold values
 ** 15 to 50 kW nominal heat production (NHP) according to current version of 1st BlmSchV. Recommendation: 15 to 100 kW NHP
 *** Target threshold, specification possible following conclusion and evaluation of research work in 2007.

the present research overlooks the fact that emissions could be still further reduced with modern technology, the FNR has proposed legalisation of straw and stalk-type biofuels and their acceptance as energy fuels within the 1st BlmSchV. In alignment with the technical developments it proposes a graduated plan for reducing emission thresholds step-by-step up to 2015.

The introduction of differentiated emission thresholds within a graduated plan in the 1st BlmSchV is sensible for alternative biofuels with regard to the comparatively higher emission potentials with wood.

Such a graduated plan would give the sector encouragement and perspective for boiler development and optimising of alternative biofuels. At the same time the respective threshold values can be aligned with the technical development standards and brought into harmony with practical demands and those for environmental protection. Without this, no significant increase in the use of alternative biofuels will be achievable and an important opportunity for the development of rural areas thus lost.

The (Table 2) adjustments and changes of the 1st BlmSchV are recommended according to the present situation in the above mentioned projects for practical exploitation of biofuels.

Additionally, performance limits for plants that do not require official approval and are fuelled by grain and other stalk-type biomass fuel should be established at 500 kW heat production output.

Information on companies offering boilers for grain and straw as well as projects and project results: www.fnr.de, www.bio-energie.de