Combustion of grape marc pellets in small and medium scale combustion systems

Background

In Germany, the total energetic potential of residues from the viniculture is approx. 4.9 PJ including approx. 265,000 t/a grape marc and 318,000 t/a vine wood. This means an oil equivalent of approx. 135 million litres and CO_2 savings of 354,000 t/a. In terms of recycling management, a marketable product should be created to improve the economic status and to offer new job opportunities in rural areas. Based on these political and economic objectives, RLP AgroScience GmbH is developing and realising new processes for the energetic use of solid wastes, residues from viticulture and vegetable gardening to establish a practical recovery strategy in terms of circular flow economy. The European patent EP 1783195B1 (Process for making fuel from grape marc, particularly in pellet form) is held by RLP AgroScience GmbH.

Figure 1: Grape marc residues

Legal framework

The revision of the German "Renewable energy act" and the market support program for renewable energy provides a challenge for the use of renewable energy in rural areas. In Germany it is necessary to distinguish whether a permission according to Federal Immission Control Regulation No. 4 (4th BImSchV) or No. 1 (1st BImschV) is needed. The recently amended 1st BImschV covers the construction, quality and operation of small scale combustion systems up to 100 kW which do not require any approval. Larger installations (up to 50 MW) are subject to licensing and emission threshold values according to the "Technical Instructions on Air Quality Control" (TA Luft). In combustion plants without permission (according to 1st BImSchV) licensed fuels are "straw, whole plants (also pellets), grains (also pellets), energy grain processing residues, husks, culms residues and similar herbaceous biomass substances (like Miscanthus or hay)" or "other renewable sources". According to 4th BImSchV no fuels are specified, only a group No. 1.3 "other solid or liquid fuels than coal, natural gas, heating oil (…)" is named. The requirements of both control regulations are listened in Table 1.

Table 1: Threshold values

Parameter	Units	1st BImSchV (1st step)	TA Luft
Nominal heat output	kW	≥ 4 – < 100	> 100 – < 1000**
Reference oxygen content	Vol. -%	13	11
dust	mg/m³ (i. N.)	100	50
CO		1000 (250*)	250
NO_x		600*	500
SO_2		-	350
HCl		-	30
Dioxine /Furanes	ng/m³ (i. N.)	0.1*	0.1

* Threshold value for type tests
** based on thermal input

Combustion of grape marc pellets

Grape marc is a manifold structured, heterogeneous mixture which generally consists of approximately 40 % solid components such as grape skins, kernels and peduncles. The amount, consistency and quality depend on the pre-treatment of the grape and mash, the type of grape, the weather and stage of maturity as well as putrescence. Grape marc pellets and blends with vine wood can fulfill the requirements of the draft of the European standard for solid biofuels (prEN 14961-6). The quality parameters of pellets from grape marc and mixture with vine wood (ratio: 70/30 Vol. -%) are listed in Table 2.

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Table 2: Quality parameters of the pellets

parameter	units	grape marc	blend
Moisture content	w.-%	10 - 13	10 - 12
Net calorific value	MJ/kg (dry basis)	19.8	19.0
Ash melting temperature	°C	910	900
Ash content	w.-% (dry basis)	6.5	5.6
N		1.89	1.70
S		0.12	0.14
Cl		0.004	< 0.005

First combustion tests with a small scale underfeed burner has shown a good applicability for the utilisation as a solid fuel. The grape marc pellets revealed good combustion behaviour which, however, caused some high gaseous emissions. In this context, the total CO-emissions are valid to insufficient air supply or rather insufficient control characteristics of the combustion system.

Figure 2: Combustion of grape marc

However, there may be problems in the combustion as well as increasing NO_x- and SO_2-emissions as a result of increased contents of nitrogen and sulphur. An advantage is a low proportion of chlorine which leads to low formation of HCl-emissions and corrosion, see Table 3.

Table 3: Results of combustion tests with pellets (n.m.: not measured)

parameter	units	grape marc	blend
CO	mg/Nm³ (13 Vol.-% O_2)	3174	~ 800
NO_x		868	352
SO_2		39	n.m.
HCl		0.4	n.m.
dust		214	n.m.

Slagging tendencies have slightly been occurred during the combustion process but had no negative impact on the bottom ash removal. Although, the dust emissions are high but can be kept with secondary measures. Additionally, blends with vine wood can improve the fuel properties and combustion characteristics.

Operators view

Due to the fact that the licencing of the combustion systems is difficult a demonstration of the technical and economic feasibility for the combustion of blended grape marc pellets has been started in March 2011. Therefore, a HARGASSNER AGROFIRE 30 will provide domestic hot water during summer in addition to an existing 920 kW wood chip boiler for space heating purposes.

Figure 3: Demonstration plant at AgroScience

The objective is to implement a marketable product in a medium-term period which strengthens a sustainable recycling management and rural economics.

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