Production and combustion of grape marc pellets and blends with vine pruning in small scale appliances

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 pruning. 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 viniculture and vegetable gardening contributing to a circular flow economy. The European patent EP 1783195B1 (Process for making fuel from grape marc, particularly in pellet form) is held by AgroScience GmbH.

Figure 1: Grape marc residues (above) and pellets made of 70% grape marc / 30% vine pruning pellets (bottom)

Production of grape marc pellets

Viniculture produces on average 2.5 t of grape marc with a dry matter content of approx. 41 % and 3 t of vine pruning with a dry matter content of 50 %. Grape marc is a heterogeneous mixture which generally consists of 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. Utilisation of residues from viniculture as fertiliser to cover losses in humus soil is possible only to limited extend. The main reasons are the seasional and short availability and the increased risk of further fermentation, rot and the related formation of odour, seepage water and mycotoxins resulting from composting. Thus, excess amounts of these raw materials are available and can be pelletised for energy production running through the following steps:

- Cleaning and storage of the grape marc.
- Drying of the cleaned grape marc by using mechanical drainage and thermal drying.
- Crushing of the dried grape marc with mechanical release of the grape seed oil contained in the grape seeds.
- Pelletising of the crushed grape marc by using a ring die press of Friedli AG, type CLM200 and some grape seed oilas additive to improve the pelletising characteristics.

Figure 2: Pelletising plant of Friedli AG, type CLM200

Grape marc pellets and blends with vine pruning 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 mixtures with vine pruning (ratio: 70/30 Vol.-%) are listed in the following Table:

Typical fuel properties of grape marc pellets

Parameter	Units	Grape marc	Blend
Diameter	mm	6	6
Mechanical durability	wt.-%	92 - 95	94 - 98
Amount of fines	wt.-%	5 - 8	2 - 6
Bulk density	kg/m³	650	630
Moisture content	wt.-%	10 - 13	10 - 12
Net calorific value	MJ/kg (dry basis)	19.8	19.0
Ash melting temperature	℃	910	900

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Typical fuel properties of grape marc pellets (continued)

Parameter	Units	Grape marc	Blend
Ash content		6.5	5.6
N	wt.-% (dry	1.89	1.70
S	basis)	0.12	0.14
Cl		0.004	< 0.005

Combustion at Agroscience

A demonstration of the technical and economic feasibility for the combustion of blended grape marc pellets has been started in March 2011 to guarantee the applicability and facilitate the licensing of the fuel. Therefore, a HARGASSNER AGROFIRE with a nominal heat capacity of 30 kW will provide domestic hot water during summer in addition to an existing 920 kW wood chip boiler for heating.

Figure 3: Hargassner Agrofire 30 (www.hargassner.at)

First combustion tests have confirmed the usability as solid fuel. The grape marc pellets exhibted a good combustion behaviour.

Figure 4: Demonstration plant at AgroScience

An advantage is the low proportion of chlorine, which can lead to low formation of HCl-emissions and corrosion. However, there may be problems by increased NO_x- and SO_2-emissions as a result of increased contents of nitrogen and sulfur in the fuel. Though the nitrogen content in the fuel is rather high preliminary combustion tests resulted in comparatively low NO_x emissions (see the following Table):

Parameter	Unit	Grape marc	Blend
CO	mg/Nm³	2735	825
NO_x	(13 Vol.-% O_2)	130	240

Minor slagging tendencies have been observed. However, the impact on the bottom ash removal was negligible. Although dust emission is high, it might be reduced with secondary measures. Additionally, blends with vine prunings can improve the fuel characteristics and combustion behaviour.

Costs

It is planned to provide local farmers of Rhineland-Palatinate with the fuel pellets. Additionally, small district heating plants or public buildings such as schools can be supplied. The raw material costs are about 45 €/t including storage, transport and drying. The pellet price is about 180 to 200 €/t by using a pelletising plant with a capacity of 1 t/h and a production of 3,000 t/year. Based on a service life of 12 years and an operation period of 3,600 hours/year the costs for the 30 kW boiler are:

Total Investment costs [€]	50,000
Total capital consumptions [€/a]	4,167
Total running costs [€/a]	9,420
Total annual cost [€/a]	13,587
Total costs over service life [€]	163,050

Challenges for the future

The major challenges for the future are:

- The implementation of a marketable product in a medium-term period to strengthen sustainable recycling management and rural economics.
- The establishment of a locally licensed fuel in combustion plants according to 1st BImSchV.
- Adaption of combustion appliances for the handling of ash rich fuels.

Contact

RLP AgroScience GmbH
Breitenweg 71
D - 67435 Neustadt an der Weinstraße
Phone: +49 (0) 6321 671 - 429
Fax: +49 (0) 6321 671 - 424
www.ifa.agroscience.de

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