2nd VegOil

Demonstration of 2nd Generation Vegetable Oil Fuels in Advanced Engines

Workpackage 6

Fuel Standard Development

Deliverable N°6.1: Study on requirements for vegetable oil standard

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1 Summary

The major dissemination effort as part of the 2ndVegOil project was to draft an acceptable text proposal for a standard that can be accepted by all the Members States of the European Standardization Committee (CEN). The ultimate EN standard needs full product and test method assessment and correlation of field experience on distribution systems and engines. The project time and the application of and experience the product around Europe were too small to reach that goal. As an intermediate a proposal for so-called CEN Workshop was made.

The Workshop was accepted an initiated by CEN in 2009. Additional experts apart from the project partners were sought and found. After a kick-of meeting in April 2010, the group continued to work with 12 organizations on a fuel specification. After the sixth meeting, the text was concluded and presented to CEN for publication as a so-called CEN Workshop Agreement. It has been published as CWA xxxxx, *Fuels and biofuels — Pure plant oil fuel for diesel engine concepts — Requirements and test methods.*

The final document specifies those properties of pure plant oil that are at least necessary to achieve smooth deployment of this fuel in diesel engines with/without exhaust gas aftertreatment, compatible for pure plant oil combustion. In the CWA two pure plant oil fuel classes are defined. These are effectively tailored towards use in diesel engines without and diesel engines with exhaust gas after treatment (catalyst, filter). Both classes are intended for, but not limited to, use in heavy duty vehicles. This is also due to the fact that all field data were from use in tractors under the 2ndVegOil project.

The CWA will be usable on a voluntary basis for engine clearance, fuel acceptance and where necessary fuelling station allowance, supporting both local regulations and international trade. In the longer term, further work in this area, including steps towards a more formal standard, will depend on whether pure plant oil and the adapted engines become available as a general automotive concept.

2 Background

Worldwide, energy policy makers are increasingly keen to move away from petroleum-based fuels to more diverse and renewable sources of energy for reasons of environmental protection, energy security and continued economic development. As an alternative for diesel fuel many countries use fatty acid methyl ester (FAME) as a biologically based alternative. With this "biodiesel" good experience has been observed and it has resulted in many specification standards, of which the CEN document EN 14214 (now in its third revision) is the best example. It is a European specification fit for all type of diesel engines, where especially the demands of light-duty, Euro V engines scrutinize the biological product.

Usual (FAME) biodiesel products are produced via a four-step process:

1. growing oil-containing seeds, mainly from eatable crops like rapeseed, palm, soy or sunflower;
2. pressing of the seeds into vegetable oils;
3. conversion via an esterification process with methanol into FAME and glycerol;
4. optimization of FAME product via additives.

From an environmental perspective, it is beneficial to refrain from using the much optimised EN 14214 quality in less demanding (heavy duty) or even adapted engines. For this the industrialised esterification process (that also includes transport to facilities) could be bypassed by using optimised vegetable oils. The most used vegetable oil for transport is rapeseed oil. At the start of the project a German pre-standard DIN V 51605 was available. However, rapeseed is not the optimal economic crop to be cultivated organically, thus not allowing fully sustainable fuel production for every location in Europe.

From a socio-economic perspective, it is also an option to set-up local production of liquid fuel and thus diminishing the amount of transport to de-centralised factories and increasing local employment. Press-mills and after-treatment equipment need less investment. The fuel quality specification should thus be independent from the feedstock grown at specific locations (e.g. rapeseed, sunflower, soy bean, jatropha).

When used in non-modified light-duty diesel engines, vegetable oil fuel not only leads to engine damages. Particularly in advanced engines equipped to EURO IV or V requirements it leads to unacceptably high emissions. Especially, particulate emissions at cold starting are exceptionally high, while at most other operating ranges the oil shows advantages compared to conventional diesel or regular biodiesel (FAME).

Heavy-duty diesel engines, although the emission requirements for EURO 5 or 6 become more stringent, can more easily match ambitious emission levels than cars in urban transport. In comparison, in the US where the diesel fleet is mainly heavy duty, a less stringent FAME quality is applied without problems. For tractors, buses and off-road vehicles optimised vegetable oil (identified as pure plant oil or PPO) can thus be a solution towards alternative fuels. This is especially interesting for (agricultural) fleet owners and for public authorities that wish to lower their greenhouse gas emissions. The amount of vehicles and thus the total fuel capacity in Europe will be low, but the impact can be large..

Until now, pure plant oil has never been adapted to existing diesel engines (except through trans-esterification to biodiesel), but always the engine has been adapted to the fuel. With a specification that sets specific quality requirements to the oil, its use may well be guaranteed for heavy-duty and other compression ignition engines. Pure plant oil does not meet the current European diesel fuel specification, EN 590, or the current biodiesel (FAME) specification, EN 14214. As it cannot be characterised by any of these documents, it needs its own separate standard specification.

The objectives of pure plant oil specifications are achieving less emission, expanding the market that is local nowadays, decreasing dependence of energy supply, and improving social economic situation of rural communities. The specification should support vehicle warranties, easier engine adaptation and improved pure plant oil treatment. As its goal is to guarantee regulated European emissions, such a specification is best to be established at the level of CEN, the European Standardization Committee. It is however also a useful tool for developing countries outside Europe where different types of pure plant oil are used for both agricultural machinery and local power generation.

Since pure plant oil is rather an innovative fuel in terms of its use and optimization steps to be taken, as first step a proposal to CWA should be developed that addresses the 100 % fuel. In addition, its use is (and shall be) not European wide, although it will be used in many countries. Next, consideration has to be given to specifications for adaptations of engines. With a CWA, clearance for engines and engine development will be much easier.

3 Objective of the work package

The goal of the work is to develop a specification for liquid fuel from oils of vegetable origin that are optimized in terms of base product and pressing process, so without additional chemical plant process steps. The fuels are intended for diesel-type engines and can be produced, treated and used locally without large investments. The idea was to specify several classes for at least two different emission requirements. By applying different additive packages use in captive fleets is considered. The specification needs to be applied outside Europe, too. Especially because it focuses on local and rural production of the fuel. The different classes can be used for diesel engines with exhaust emission after-treatment systems, but obviously also for older or different engine concepts.

4 Work undertaken within the project

4.1 CWA proposal

4.1.1 Kick-off meeting

After the start of the project the first ideas were developed. Together with VWP and John Deere, a short presentation by NEN to CEN Technical Committee 19, Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin, at its 2009 plenary meeting was prepared. CEN/TC 19 is the European fuel specification drafting committee. Its members agreed that there was no need for a European wide standard and that the industry could apply a Workshop procedure as a tool to develop a specification.

Following the first positive outcomes of other 2ndVegOil work packages, a draft business plan for a CEN Workshop was drafted over summer 2009. After a short check within all the project partners, the work package partners chose to make a short unofficial consultation within the DIN standardization and the CEN diesel working group (WG 24). The first group

had developed DIN V 51605, a pre-standard for diesel fuel based on rapeseed oil. Not only had the 2ndVegOil partnership used their text as basis for our first proposal, but it was also essential to maintain good relations with that group in order to harmonize requirements and also to gather participants for our workshop plans.

Once, the first positive data within 2ndVegOil came available on oils other than rape seed, the business plan and a draft standard text were further developed. The original idea of proposing different standards for four base oils (rape, sunflower, jatropha and camelina sativa) was left following discussions with CEN and other experts. The project had shown that the applied optimized pressing process presented no large quality differences on the oils. Next, market players in DIN and CEN advised against proliferation of different standards, also because the proof of the origin of the oil would be more difficult and expensive than the benefit of the quality of for instance rape against camelina sativa.

The final draft business plan was proposed to the CEN in January 2010. The Management Centre accepted the idea and a kick-of meeting was scheduled for April 2010. The partners then announced the initiation of the workshop on their websites or distributed the news amongst their contacts. A press release was made and distributed for instance amongst the CEN diesel and biodiesel experts, but also amongst French and German oil producers and farmers.

On 7 April 2010, the kick-off meeting of the CEN Workshop 56, “Vegetable liquid fuel from virgin (non-) food oils for use in heavy duty diesel engines", took place (see Annex A). Fifteen people from eleven organizations took part in the discussions. The background to the idea was explained by VWP and NEN. The group agreed to appoint Georg Gruber of VWP as its chairman and accept NEN as the workshop secretariat.

The title and scope were discussed and amended. The non-food issue was felt to be beyond the scope of a technical fuel specification. Next, the business plan was updated and approved by the group. The terminology to be used was discussed and both "straight" and "pure" just as "plant oil" and "vegetable oil" were seen as equal terms as they were common use in the market. The title of the workshop was reworded: *Fuel quality specification – towards pure plant oil application in diesel engines.*

A detailed specification on the basis of DIN V 51605 and EN 14214, plus input from the 2ndVegoil project was agreed to form the basis of further workshop discussions. There should be no properties with unnecessary more restrictive requirements in the 2nd vegetable oil standard than in the actual European biodiesel or diesel (EN 590) standard. But also, reflection on EN 14214 is needed as the products will or shall be able to use the same distribution system all over Europe as for regular (bio)diesel. The idea of two or more qualities being specified on the basis of engine needs guided by emission requirements was underlined. Also because some participants saw possibilities in developing countries for local production.

The group left each other with the task to check the first text proposal on what would be needed to specify. An action plan was agreed upon.

Figure 1 – Participants to the kick-off meeting

4.1.2 Text development

The workshop continued for four meetings over the period June 2010 to April 2011. Basis of the talks was a comment table generated by NEN before the second meeting in Brussels compiling the input of all workshop participants. That meeting started with a technical presentation on the results of the 2ndVegOil project in order to get a feeling of what the cleaning and filtration could deliver. It clarified where differences between straight- and optimized-pressed plant oil. In addition the on-going work at CEN on contamination and cold operability were presented by NEN.

A start was made with deciding on the naming of the product. EC Directives and Tax Rules were studied as one participant suggested to use "virgin" instead of "pure". Looking at the common language in most markets in Europe, pure vegetable oil (PVO) and pure plant oil, PPO, were to be used as equal indications. PPO would be the leading term as it is more common. Another common indication, Virgin Oil Liquid Fuel (VOLF) is designated as an example of a cold pressed PPO. At a later meeting, recycled oils were excluded from the specification as there stability capacity would be unknown for the user.

The input of all participants regarding the text proposal distributed in the first meeting were handled one-by-one. Particularly the dilemma of being too easy and then risk engine failure versus being too strict and hence expensive in the specification was highlighted. Soon in the discussion the need to limit to two PPO classes was seen as the best way forward to enable the group to define acceptable classes for production or engine warranty. After the first meeting, some open questions remained on matters that could not be totally covered by the experience with DIN V 51605. These were further studied and discussed during the following meetings on the basis of literature research, small lab tests and further input of 2ndVegOil project results.

The major discrimination between the two classes would be the lowering of the metals content. Limit values especially for Potassium (K), Sodium (Na), Phosphorous (P), Calcium (Ca) and also Magnesium (Mg) are very important for failure free use of PPO in diesel engines. These ash forming elements are on the one hand naturally present in plant oil and can therefore only be removed or reduced by refining, or by applying treatment systems with filter aids especially developed for decentralized oil mills. On the other hand high values of these elements raise deposits and wear effects in PPO enabled engines. With the background of increasing technical requirements from advanced or future engine concepts a further alignment of the level of these deposit building elements will be even more important, especially phosphorus and sodium and potassium.

However, the group did not want to pressurize the oil producers to execute several tests. A literature study and a set of different oil tests before and after the treatment process were executed There seemed to be a linear correlation between the amount of P and that of Na and K, but a less precise correlation towards Ca and Mg. The group accepted the fact that the phosphorus content would present sufficient indication that for the (effect on the cleaning for) other metals except calcium and magnesium. The (Ca+Mg) requirement is maintained in the CWA and a general explanation on ash forming elements was written. A discussion took place on the actual limit. Most people felt that a total of 2,0 mg/kg on metals was acceptable for EuroV. Some wished to set limits at 0,5 ppm, but as this would seriously increase the test cost and the need was not that great according to the OEMs, it was agreed to set both limits at 1 ppm maximum for the higher emission requirement class (PPO2).

In the beginning two PPO classes were taken as the basis of the fuel specification. They would, on the basis of their ash forming elements and metals content, be fit for Euro V or lesser emission requirement engines. The lowering of the metals content can be achieved by an extra physical treatment process after the oil pressing. Some experts in the group wished to introduce an intermediate class, which quality can be achieved by an optimized pressing process. However, the majority saw no need to present that quality as a class as it would demand a serious quality control on pressing and seeds. Such guarantee on lower levels could be used for marketing purposes.

Total contamination was a smaller discussion matter. Filter clogging in the tank (car and farm) is a problem. However, no better solution than adopting the European FAME limit and test method was in the end found suitable. Some experts wished to present lower limits than for regular diesel as the improved pressing processes could go lower. However, the OEMs accepted the 24 mg/kg limit and saw no need to discriminate at this point in time where experience with the pressing was limited to guarantee a continuous quality level.

Acidity higher than 2 mg/kg endangers engines for risks like corrosion, coke residues on injection components, piston, and piston rings. Free fatty acids can also react with the lubrication oil and lead to polymerisation. The acid number increases with the factors temperature, moisture and maturity of the seed material. Due to a high water content and hydrolytic and enzymatic processes, the content of free fatty acids in pure plant oils increases. Especially for various plant oils in tropical or semi-tropical areas with long transportation distances from the producer to the customer, a quality control of the seed material for moisture, temperature and maturity is more important than for rape seed which is grown in colder areas with small transportation distances. At the fourth meeting results of some tests were tabled, showing that acidity also highly depends on the pressing procedure. It was considered to require a lower value for the PPO class for higher emission requirements. As the acidity shall not be too high in order to cause irreversible damage, but a too low acidity level will unnecessary limit the use of different cops, the level was set at 2,0 mg KOH/g for both classes.

For oils, being natural products known to coagulate at lower temperatures, the oxidation stability and winter properties are essential. The developments and methods used by ASTM and CEN were studied during the third meeting. Applicability of cold filter plugging point (CFPP) for oils was debated as were the impacts of storage time before pressing, local climate and eventual tractor adaptations. The recently standardized Rancimat test for diesel and FAME blends was considered. Test were executed to check the applicability on PPO and as a matter of alignment the same requirement as for FAME was adopted.

Winterization was discussed at the fourth meeting. The DIN group had concluded that the usual CFPP test would not be applicable to PPO. Not many waxing problems were observed within 2ndVegOil or at the sites of other workshop participants. Still, the engine had to start at cold temperatures. The various viscosities of the oil feedstock were studied and debated. The group felt a simple solution for cold climate viscosity requirements was needed. When OEMs needed to adapt every engine there would be no standardization. Also in order to exclude as little oil types as possible for use, the idea of introducing classes was further developed.

At a next meeting, test data on filter blocking tendency of several PPO's were discussed. Although promising as a performance indicator, it was felt that it would be better to continue on a combination of viscosity or density with temperature classes. Several viscosity curves were researched. The group developed a new idea around operation temperature, originating from the fact that CFPP, cloud and pour point have less relation to the effective startabil-

ity of the engine. On one side the idea includes a way of checking for the lowest operation temperature for a certain oil. On the other side it captures need for a certain oil viscosity class from the OEM perspective. The aim of achieving 150 cst of viscosity is based on the ability of oil pumps to press the fuel through the filter. The group agreed to introduce a second table with the concept of Lowest Operational Temperature (LOT) and maximum Kinematic Viscosity for permanent operation (KV_{OP}) requirements. An excel sheet that people could use to fill in actual values to check how things would work out for the needed LOT for the oils and the Temperature to Start Operating (TSOP).

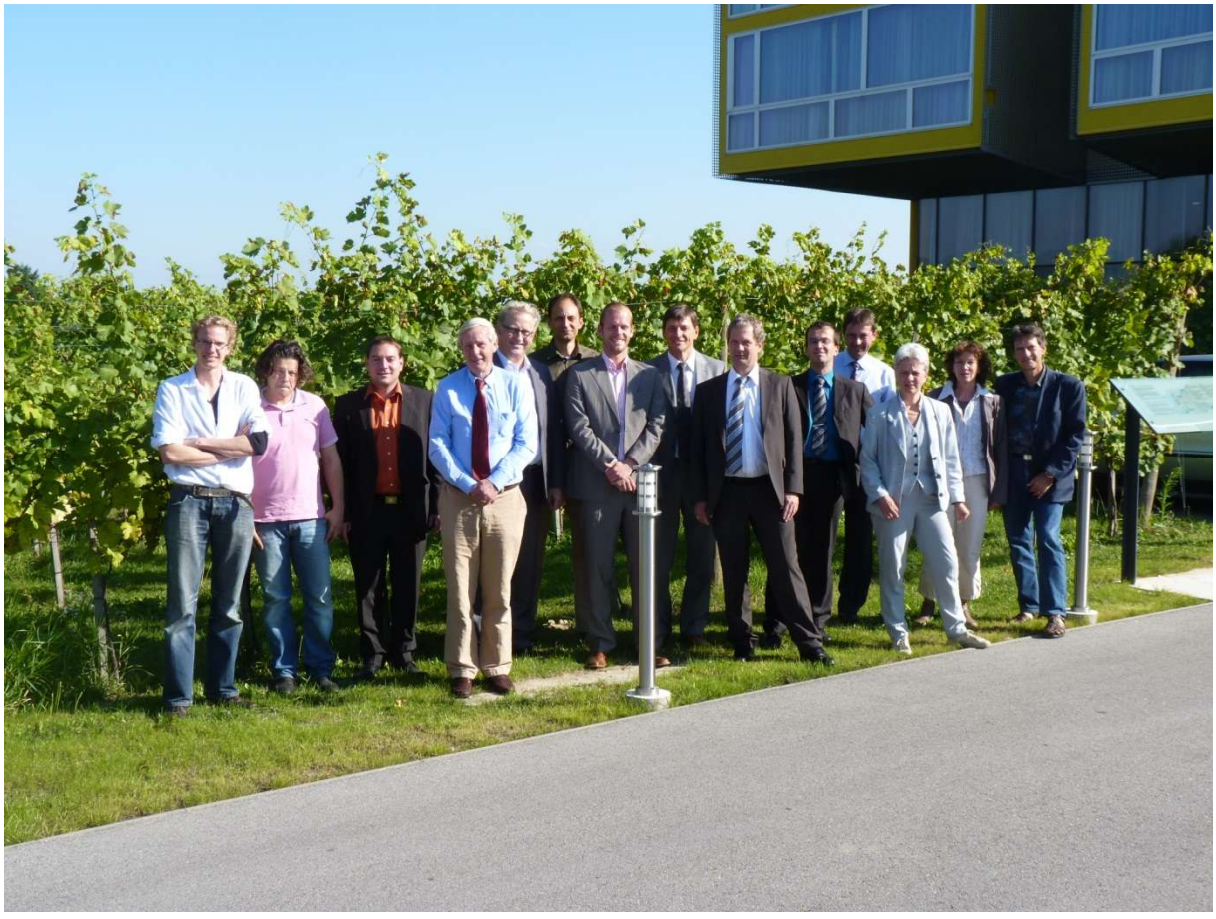

Figure 2 – Workshop participants at the third meeting in Langenlois (AT)

Cetane number, an identification of the ignition quality of the fuel, was debated as a better property related to diesel engines and equipment expectations than calorific value (as used by DIN). The customer needs to be able to start the engine. Alternatively, the fatty acid structure of a PPO would guarantee good burning behaviour. At the second meeting, the group felt that the cetane number was a little bit like the holy grail in burning behaviour, so work was continued on that route. Further checks were done if the new methodology of a derived cetane number (for which not a large, cumbersome test engine would be needed) could also for PPO be an alternative. The differences in cetane for camilina sativa (32) to jatropha (54) needed to be taken into account. Also a short study on the seemingly impact of the oil treatment process on the cetane – sometimes it raises cetane from 38 to 44 – were studied.

At the fourth meeting, the group concluded that a correlation for PPO and derived cetane number (DCN), as measured by so-called CVCC equipment, did not exist. It would take the group too far to develop it. The manufacturers commented that they used fuels with cetane numbers from 36 up to 56 without problems in their common rail systems. It might be different for older type or one-cylinder engines that have less adaptation possibilities. In the end, it was agreed upon to include a paragraph on ignition quality that explains the need by the OEMs, the problems with reliable measuring it for PPO or correlating it to the engine functioning. This would replace cetane in the table of requirements.

At the fifth meeting the issue of acid types was tabled again. The quality of biodiesel is fixed in EN 14214; therein content of linolenic acid C18:3 is maximized at 12 % (*m/m*). The German DIN committee had meanhwil drafted a revision of DIN V 51605 (DIN 51623), wherein they would follow EN 14214 and also limit the content of linolenic acid to 12 %. Highly unsaturated plant oil fuels show a lower thermal stability and a longer ignition delay than saturated plant oils. With increasing unsaturation of the oil, therefore, also the risk of carbon deposits of unburned fuel on injection nozzles, piston and piston rings increases. This is the case for direct injection engines, a study for different biodiesel qualities detected equal effects . Following EN 14214 and DIN 51623, Camelina Sativa with a linolenic acid content of up to 40 % (*m/m*) could not be used as engine fuel. In the 2nd VegOil project so far good engine experiences existed for more than 500 hours with John Deere common-rail engines and Camelina Sativa with a linolenic acid of 40 %. Also experimental tests with different plant oil fuels showed no significant difference in torque, power and emission of Camelina Sativa. The group noted that one cannot compare plant oil with biodiesel requirements and that the impacts are yet unknown. In the end, the group concluded that setting a linolenic acid limit did at this stage not have a ground.

4.1.3 Enquiry amongst the stakeholders

At the fifth meeting the draft CWA text was finalised in largest detail. A list of contact, mainly OEMs was assembled. NEN presented the draft text to these experts by e-mail on 27 June 2011 allowing them two months to react. In parallel the text was submitted for comments to the CEN/TC 19 working group on diesel fuels.

After September 1st, a table of all comments received was gathered and distributed within the group. Comments were received from MAN, Deutz, DAF Trucks and FNR. They have been answered at the 6th workshop meeting and all commenters have been personally informed about the responses. Many commenters brought valuable input and further clarification sentences and notes were introduced in the CWA text.

Figure 3 – Meeting at John Deere factory in Mannheim

4.1.4 Finalization of the text

At the 6th meeting, the decisions regarding the comments received were introduced in the text. An Annex on startability explaining the LOT and T_{SOP} was developed and introduced. It was agreed to have the excel sheet and further explanation published on a separate website. As not all workshop participants were present at that meeting and the text had been updated, a couple of weeks were given to the participants to officially agree to the draft text. On 1 November 2011 the workshop chairman concluded that all participants had accepted the text. On 3 November, NEN forwarded the text to CEN, which edited it and published it on 7 December 2011 as CWA 16379.

4.2 Specification marketing

The project partners made several efforts to include additional organizations in the specification development work. Additional workshop participants were:

- ACRO-KHLIM (BE), a research group undertaking several pure plant oil work;
- Bearth Energy Systems (NL), a company specialised in energy solutions in developing countries (especially Africa);
- European Pure Plant Oil Association (FR), a French oil producers association;
- IESPM (FR), an oil test laboratory;
- Mature Development (NL), a consultancy for new technology developments;
- PPO.be (BE), an oil producing company;

- SolarOil Systems (NL), an oil producing and engine installation company.

The workshop participants all used their websites, newsletters and for some presentations at conferences or exhibitions to market the workshop.

By exchange with the DIN committee developing the revision of DIN V 51605, further marketing for the work was done. Specific members of this committee were included in the enquiry (see §4.1.3).

The project partners prepared an article on the development and explanation of the new ideas around the LOT and KV requirements newly introduced by the CEN Workshop. Mainly John Deere prepared the paper assisted by some workshop participants. In addition Mature Development and Bearth wrote a paper together with the project partners for the December 2011 issue of "Biofuels International Special". This will be a less technical article and the hope is that it can be published in more magazines, also in translated format.

As a last remark: the process entertained by the CEN workshop will be part of a PhD study executed by Mr D. van Doren of Mature Development for a thesis on decision making at the Stuttgart University in Germany. Mr. van Doren has participated in almost all meetings and his thesis is to planned to be finalised in 2014.

5 Requirements for pure plant oil standard.

5.1 CWA 16379

The requirements for pure plant oil (or pure vegetable oil) are laid down in CWA 16379. This specification is based on DIN V 51605 (and information by DIN on the development of the new DIN 51623), but improved and made feedstock independent. The objectives of pure plant oil based fuel specifications are achieving less emission, expanding the market that is local nowadays, decreasing dependence of energy supply, and improving the social economic situation of rural communities. Pure plant oil used as engine fuel has potential for the most comprehensive ecological, economic and social benefits of all biofuels.

The CWA is usable on a voluntary basis for engine clearance, fuel acceptance and where necessary fuelling requirements, supporting both local regulations and international trade. In the longer term, further work in this area, including moves towards a more formal standard, will depend on whether pure plant oil based fuel and the adapted engines become available as a general automotive concept. The Workshop will in this respect maintain close contact with CEN/TC 19 "*Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin*"

CWA 16379 specifies those properties of pure plant oil (PPO) that are at least necessary to achieve smooth deployment of this fuel in diesel engines with/without exhaust gas after-treatment, compatible for PPO combustion (see Annex B). Two PPO fuel classes are de-

fined. These are effectively tailored towards use in diesel engines without and diesel engines with exhaust gas after treatment (catalyst, filter). Both classes are intended for, but not limited to, use in heavy duty vehicles). The specification is valid at the point of delivery. The delivery can be from an oil mill to a purchaser or from a fuelling station to a driver.

Since experience for long term and failure free use of PPO compatible combustion engines is limited, this document is not yet a comprehensive specification, but more limited to specific properties. Only those properties that are seen as necessary for minimum quality requirements in the current technical discussion have been included. The main differences between PPO and automotive diesel are in the areas of density, viscosity, contamination level and flash point.

Any oil seeds can equally be used for the production of PPO, when the produced plant oil fulfils all individual requirements of the properties and limits mentioned in this workshop agreement. CWA 16379 has mainly been based on experience with seeds of the following oil plants: rape, canola, sunflower, Camelina sativa and Jatropha. This document lays down properties and values for the use of PPO at present deemed necessary, along with the test methods for these properties to be applied. Application of the in this document defined PPO for vegetable oil compatible combustion engines is only allowed when warranties have been given accordingly from the engine or equipment manufacturer.

Figure 4 – Finalizing the text at CEN in Brussels

5.2 Additional considerations

Further properties can be included in later versions of CWA 16379 as they become available from successful technical and analytical test results. The specification is valid at the point of sale. Blending with diesel fuel, paraffinic diesel or FAME is not covered in this edition of the CEN Workshop Agreement. If the need arises for blends of PPO with diesel a revision process will be considered.

The production of PPO according to the requirements of CWA 16379 takes place by mechanical cold or hot extraction or by mechanical extraction with aid of solvents. In any case control measures like refining or solid-liquid separation are aimed to minimize content of undesirable contaminants and solid particles in the PPO.

Based on studies within the project it is recommended not to define a single, fixed maximum viscosity level for PPO, but to set a specification according to engine's and applications specific needs which can be fulfilled by multiple types of PPO. This is achieved by two ideas represented by two indexes: a maximum kinematic viscosity for permanent operation (KV_{PO}) and a lowest operational temperature (LOT). This concept is new and needs to be assessed on the basis of future experience. It might as well be further standardized within CEN.

Annex A – Kick-off meeting agenda

CEN WORKSHOP 56

ON "VEGETABLE LIQUID FUEL FROM VIRGIN (NON-) FOOD OILS FOR USE IN HEAVY DUTY DIESEL ENGINES"

Fuel quality specification – towards pure plant oil application in diesel engines

KICK OFF MEETING

7th April 2010 – 10:00 – 13:30 - 17.00[1]

Venue :

CEN/CENELEC MEETING CENTRE

Avenue Marnix, 17 - 4th floor

B - 1000 Brussels

Room Newton A

Draft agenda

1. Opening of the meeting	10:00
2. Roll call of participants	10.05
3. Adoption of the Agenda	10.15
4. Presentation of Workshop concept by Gaïd Le Gall Programme Manager, CEN-CENELEC Management Centre	10.20
5. Background to the Workshop proposal – Georg Gruber (VWP), Ortwin Costenoble (NEN)	10.50
6. Official establishment of the Workshop 56 on "Vegetable liquid fuel from virgin (non-) food oils for use in heavy duty diesel engines	11.30
• Discussion on title and scope	
• Discussion and approval of the WS 56 Business Plan	
• Election of Chairman and appointment of Workshop Secretariat	
• Sign up of actual workshop participants	
7. End of the public meeting	12.30
Lunch Break (12.30 - 13:30)	
1/8. Start of first Workshop 56 meeting[1]	13.30
2/9. Workplan	
3/10. Background on vegetable oil fuel quality standards	
4/11.Discussion on fuel requirements of modern diesel engines	
5/12. Action plan	
6/13. Next meeting date(s)	
7/14. Closure of first workshop 56 meeting	17.00

Annex B – PPO table of requirements

Property	Unit	Limits				Test method [a]
		Direct processed		Improved quality		
		PPO1 minimum	PPO1 maximum	PPO2 minimum	PPO2 maximum	See CWA 16379
Visual aspect	--	Free from visible contamination, sediment and free water				
Density at 15 °C	kg/m^3	910,0	940,0	910,0	940,0	
Flash point	°C	101	–	101	–	
Lower heating value	kJ/kg	36 000		36 000		
Sulfur content	mg/kg	–	10,0	–	10,0	
Water content	mg/kg	–	750	–	750	
Total contamination	mg/kg	–	24	–	24	
Oxidation stability at 110 °C	h	6,0	–	6,0	–	
Acid value	mg KOH/g	–	2,0	–	2,0	
Phosphorus content	mg/kg	–	12,0	–	1,0	
Ca + Mg [g]	mg/kg	–	20,0	–	1,0	