039-mwj-sm

3 August, 2004

Graeme Marshall
Director Clean Fuels
Department of the Environment & Heritage
GPO Box 787
CANBERRA ACT 2601
Via email Graeme.Marshall@deh.gov.au

Dear Graeme,

We are pleased to submit our comments relating to the proposed Diesohol Fuel Standard. These comments have been prepared by Wells International in conjunction with and on behalf of CSR Ethanol.

Yours sincerely,

General Manager
CSR Ethanol

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Comments on behalf of CSR Ethanol on *Setting National Fuel Quality Standards Paper 7, Discussion Paper on Diesohol*

Prepared by Dr. W. J. Wells, WEI Pty. Ltd.

These comments are prepared on behalf of and in consultation with CSR Ethanol. The content is solely the responsibility of WEI Pty Ltd.

Comments appear in the order of text in the paper. Comments are from the view of a fuel grade ethanol producer who wishes to participate in this emerging market. Lack of a comment on a particular topic means that CSR has no experience, involvement, or quarrel with that segment of the report. Of note, personnel in CSR Ethanol have experience in manufacturing the Apace-brand of diesohol using hydrous ethanol at the Sarina, Queensland distillery.

■ Section 4.2, pages 13-14, does not list Lubrizol as a potential supplier of products and technology, whereas we believe that they are active in this area.

■ Section 4.4, page 17, invites stakeholders to provide comment on the issue of vehicle warranties and the use of diesohol. Based on the contentious experience in Australia with E10 petrol blends, despite their long history in the USA, it is unlikely any local manufacturer or importer of diesel equipment in Australia will accept this new fuel in current or contemplated models.

If parties wish to see future warranty statements covering any particular variant of diesohol, then the efforts need to begin today to have any hope of a favorable result. It is our belief that this activity is underway in the USA, but the E10 history here proves it will have to be repeated in Australia. In the absence of such statements, users of the fuel will have to rely on their own judgment in its use, knowing that the warranty may be violated.

■ Section 5 on page 18 asks for comment on the various options for action. Option 1, which is no action or business as usual, is unacceptable for a host of reasons. Not only will adulteration without penalty or recourse inevitably result, but irrevocable harm to the industry could occur in the form of user confidence. We prefer a federal standard applicable nationwide.

This has competitive implications as well, for all producers should have to make a similar commitment to manufacturing equipment and operational quality standards. We also believe that anhydrous ethanol for the variants of diesohol that you call “solutions” (whether true solutions, micelles, micro-emulsions, or whatever) should conform to the same standard and specification as ethanol used for making E10 in petrol. An internal combustion engine is pretty much the same whether a spark or compression provides the ignition source, and this would hold the number of grades a fuel-dispensing terminal would have to store to one.

■ We offer a general observation for section 6, critical parameters, beginning on page 22. We believe that there are no methods available that are appropriate for testing mixtures of diesel fuel and ethanol, and indeed one or the other component might interfere with the other. Such interference would only be found after many rounds of testing such as is done by members of the D2 committee of ASTM members. There are, however, testing methods separately for diesel fuel and fuel grade ethanol, and these should be used to ensure that the base materials are on

specification prior to blending. This is similar to what is done with E10. If future approved testing methods issue from ASTM, they can be considered at that time.

We believe that it is unnecessary for ethanol producing companies to equip their laboratories to handle hydrocarbon fuels and test them when this is the domain of oil companies, but it is appropriate for them to guarantee the quality of the ethanol they produce. We have no opinion on how one would ensure the quality of the host of surfactants and ignition improvers that might be used in these applications.

A copy of the CSR specification for fuel grade ethanol, with corrosion inhibitor, is attached to this report. Likely, blenders will want to add their own corrosion protection package, as is done with most straight hydrocarbon fuels today. CSR add this ingredient at the request of certain customers, while others add their own ingredients.

■ Section 6.1 invites comment on acidity. We have no opinion on the acidity of the base diesel fuel. Our investigation reveals that the two tests mentioned (ASTM D974 and D664) seem to be used only for hydrocarbon petroleum materials, such as diesel fuel. Further, they yield an "acid number," which is not precisely the same as acidity content.

For fuel grade ethanol to be blended into diesel fuel (or any internal combustion engine fuel), we believe that the maximum acidity level specification proposed (equivalent to 800 ppm KOH) is nearly 30 times too high. A more appropriate number is 30 ppm as acetic acid measured as a maximum of 1.0 ml of 0.01N NaOH. This is equivalent to 28 ppm as KOH or 0.028 mg KOH/g.

Part of the reason for this suggested value is to have a standard product at terminals for blending into either petrol (gasoline) or diesel fuel (distillate). The value of 30 ppm as acetic acid is the current ethanol standard for petrol blending.

An equally important reason is the need to protect the investment made in the engines of the diesel users, which in the case of heavy duty engines for trucking, power generation or mining can be considerable.

Relatedly, if long term durability issues (metallic corrosion) in engines appear after long periods of use, it might not be possible to recover user confidence in these fuels, when a simple reduction in acidity might have sufficed in the beginning. In this regard, use of an appropriate corrosion inhibitor might be pre-added to the ethanol for convenience of the blender, such as is done with DCI-11 at 86 mg/L so that when a 10% blend in petrol is made, the concentration will be correct for the entire blend. Refiners and blenders will have to tell ethanol providers which additive they prefer for diesel fuel.

We recommend the inclusion of the pHe test for acidity, ASTM D6423. While not entirely understood what it is measuring as opposed to other acidity tests, use of this special electrode in the potentiometric determination seems to correlate well with real-world corrosion experience. Although this is primarily an issue for neat alcohol fuels such as E-85, this test has moved into the mainstream realm of low-percentage blends such as E10 as well.

As a corollary, the pHe test is performed after denaturant is added because of the potential for a high acidity in the denaturing petrol that might be undetected otherwise. This raises the issue of whether denaturant (nominal 1%) should be added to ethanol for diesohol. We believe that the only area of concern to diesohol would be cetane reduction, but petrol is higher in this regard than ethanol, so no degradation would be expected compared to undenatured ethanol. Also, the denaturant would be completely soluble in diesel and might act as a co-solvent for the ethanol.

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■ Section 6.2 covers ethanol quality. Taking your points listed in order, we believe that the providers of the diesohol technology each have their own individual maximum on alcohol content, so a general cap is hard to define. While 15% might be fine for one blend, it might be too high for another. Generally speaking, however, we agree that we know of no technology that requires more than 15% and, remembering what happened with petrol blending, we think a cap at 15% is appropriate.

Deciding a parameter for alcohol content is complicated by more than whether hydrous is used or not, because fuel grade ethanol is not just the chemical species ethyl alcohol. It also has denaturant and various fusel oils such as isomers of amyl alcohol, which are excellent fuels and would help as co-solvents in diesel fuel. Determining oxygen content as a specification for the final diesohol could be a very expensive procedure on a case by case basis. Instead, we think DEH should coordinate with ethanol producers to determine what typical oxygen content for "ethanol" is, and then calculate what final oxygen contents might be for various percentage blends, given that none will be coming from the base diesel. This is if you want to use oxygen as a parameter.

For enforcement, there are water-extraction tests that measure the amount of fuel ethanol present in any hydrocarbon fuel that result for careful experiments involving correlation with know amounts of fuel grade ethanol added, and also noting the temperature.

We agree with your last comment that DEH should investigate the possibility of controlling the quality of ethanol, to be used for making diesohol, separately. As stated already, a copy of the CSR specification is attached as a guide. Then for enforcement purposes, you can correlate extraction tables for ethanol (and other species present) using a typical ethanol product. This is usually a simple observation of amount of aqueous layer increase upon extraction with a known quantity of water.

■ Section 6.10 covers water content. We believe that "free water" is a nebulous issue in the case of hydrous technologies such as Apace, as evidenced that the solution can take certain amounts of additional water being added without breaking the emulsion. We agree that there should be some basic limit on the amount of water present in the hydrous ethanol before blending, however, to prevent the emulsion from breaking and the formation of two distinct layers in the storage tank if water is accidentally introduced.

Whether the water is free in the sense of actual droplets as opposed to evenly distributed in solution in the base diesel fuel will become moot when ethanol is added because you now have new conditions where the water will associate itself with the ethanol as closely as possible, whether it was a suspended drop or dissolved originally. In an emulsion technology, most of the water from the diesel fuel (if any) will migrate into the alcohol-water droplets. In a solution technology, addition of anhydrous will stabilize whatever water was present originally as an evenly distributed solution. We do not believe that enough water can be dissolved in base diesel fuel to be of any consequence in the final diesohol, so if the spec for diesel is 500 ppm, we recommend that it stay there.

As a practical matter, any test you apply to emulsion diesohol for water determination will seek out the water in the emulsion droplets and "count" them. Since the base diesel fuel will be nearly dry according to the 500 ppm spec, then you can control the water content in the ethanol and be assured of final water content as essentially all coming from hydrous ethanol. So far as we know, the Apace technology has worked with 96% ethanol from CSR and what we assume to be 95% ethanol (5% water) from Manildra. We do not know which water content makes a

superior emulsified fuel. It is obvious that 4% water is a superior starting place in the sense that you have more protection from phase separation.

It is not necessary, we believe, to have water in anhydrous ethanol at 500 ppm. Ten times that amount, 5000 ppm or 0.5%, will be typical in fuel grade ethanol should it become a standard product, although the specification is actually higher at 1% or 10,000 ppm water. While the higher amount is permitted for petrol, modern molecular sieve dehydrators typically produce 5000 ppm water, and this is what will be commonly available.

For the solution-style of diesohol, the resulting mixture has different physical properties than the starting diesel fuel. It will hold more water. The technology providers can advise you on this.

In any case, the amount of water in the ethanol will be diluted as it goes into diesel fuel. If the diesel fuel is at 500 ppm water and present at 85%, the ethanol is at 5000 ppm and present at 10%, and the additive package is also 500 ppm water and added at 5% (just an assumption, we have no knowledge of the actual water content of the additives), then the final water content will be 0.85(500) + 0.05(500) +0.1(5000) = 950 ppm water. So far as we know, groups demonstrating this technology in the USA have been using conventional fuel grade ethanol produced for petrol specifications. We recommend, if technology providers concur, that anhydrous ethanol for diesohol be at 5000 ppm or 0.5% water.

We might also point out that average ambient temperatures in Australia are higher than those encountered in the USA, especially in Northern tier States in winter, so water separation will be less of a problem.

In all your other areas we have no comment except to say that tests for diesel fuel are probably not applicable for diesohol and so individual testing of the constituents (diesel, ethanol, and additives) is preferred.
END

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PRODUCT SPECIFICATION SHEET
ETHANOL
100 Fuel Grade with Corrosion Inhibitor
(Special Methylated Spirits)

CODE

100SGF21 CI

CAS Number: 64-17-5

PARAMETER	TEST METHOD	SPECIFICATION LIMIT
DESCRIPTION	BP2002	Clear, colourless, volatile liquid, hygroscopic, miscible with water and with methylene chloride, free from matter in suspension and apart from water, consisting essentially of ethanol.
STRENGTH	BP2002	99.4% (min.) ethanol v/v at 20°C
RELATIVE DENSITY	CSR AP-03	0.793 (max.)
WATER CONTENT	CSR AP-27	1.0% by weight (max.)
ALKALINITY	BP2002	Alkalinity to Phenolphthalein – Nil
ACIDITY	BP2002	1mL of 0.01N NaOH (max.)
CLARITY OF SOLUTION	BP2002	Dilution of 1mL sample to 20mL water should remain clear and colourless after 5 minutes.
ALDEHYDES & KETONES	BP1973	100ppm as Acetaldehyde (max.)
REDUCING SUBSTANCES	BP1973	30 minutes (min.)
NON-VOLATILE MATTER	BP2002	2.5mg/100ml (max.)
VOLATILE IMPURITIES	BP2002	Passes Test
pHe (after the addition of denaturants)	ASTM D6423	6.5 – 9.0

Tests are carried out in accordance with the requirements of British Pharmacopoeia 2002 (with additional tests carried over from British Pharmacopoeia 1973) prior to the addition of denaturants.
Safe handling information for this product can be obtained from the MSDS.
Product is manufactured under a certified Quality System.

FORMULA	DENATURANT	SPECIFIC GRAVITY (Max @ 20°C)	CONCENTRATION (Nominal)
F21 CI	Unleaded Petrol	0.793	1% v/v
	Corrosion Inhibitor (DCI -11)	0.94	86 mg/litre

Special Methylated Spirits is ethanol which has been denatured in accordance with Regulations under the Spirits Act.