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25 Jan 2007

SUBJECT:
DEPARTMENT OF ENVIRONMENT AND HERITAGE DISCUSSION PAPER, *"STANDARDISING DIESEL/BIODIESEL BLENDS*

Dear Sir:

My comments on the captioned Paper are provided below. These comments are offered in my personal capacity.

Recommended Approach

I do not support any of the management options provided in the discussion paper.

In summary, my view is:

1. There should be no prescribed or mandated cap on percentage of biodiesel in blends.
2. There should be a standard that applies to the final blended product. This standard may be met either by certified quality compliance after blending, **or** (for most properties) by certified quality compliance of the pre-blend feedstocks. For these nominated properties, pre-blend compliance may be deemed to make a complying blend. However, in the absence of pre-blend certification, compliance may also be demonstrated post-blend.
3. A minimum of (nominated) properties must be certified post-blend (eg to ensure proper mixing).
4. The NOx emission of biodiesel blends should be neutral (ie no higher than current diesel emissions).
5. The S level of biodiesel should be compatible with the diesel specification (ie 10mg/kg max).
6. More flexibility and the widest possible range of methods should be permitted in the standard testing methods, so that biodiesel compliance is not hindered by restrictive or incomplete analytical methods.

Overview

Logically, an automotive vehicle fuel specification need only be concerned with the properties of the final fuel product. The individual constituents that this fuel is made up from are of limited or no relevance. This principle is generally accepted for fossil diesels which may have a very wide variety of individual components and differ over wide ranges depending on source oil and refinery processes, while still meeting final product specifications.

Importantly, it is incorrect to believe that simply meeting the mandated diesel specification (Fuel standards determination (diesel), 2001) is sufficient to guarantee that the product is suitable for use in modern engines or 'fit for purpose'. A variety of inappropriate blend materials, additives and adulterants can be used, with the final product still meeting the letter of the specification. All fuel majors require products to meet many more formulation requirements than are legislatively mandated, and even then difficulties arise (eg the small vehicle diesel/component compatibility problems in Queensland in 2001; light aircraft aviation fuel problems across Australia in 2000).

The principle that a suitable diesel fuel can be obtained in a variety of ways and from many different feedstocks should also apply to biodiesel/diesel blends: it is the final blend properties that are of interest and ultimately requiring regulation. If the final blend specification is required to meet, for example, the diesel specification (Fuel standards determination (diesel), 2001), then whether the constituents come from fossil or biological or synthetic feedstocks – and how these are processed (by distillation, transesterification, hydrotreating, cracking, chemical- or bio-synthesis, amongst others) is of no real significance as far as the product fuel is concerned.

If this position is accepted, two important consequences arise: conformance testing methods (since the current standard methods are quite inflexible for diesel and cannot be used for many non-conventional blending components, see later); and fit-for-purpose liability. The latter is most appropriately left to market forces to sort out – familiar territory for fuel suppliers where it has been handled before, including through compensation payouts, when breeched. In practical terms, compatibility and liability concerns are likely to limit general consumer acceptance in the short term to relatively low biodiesel blends depending on what engine and component manufacturers may recommend, or a fuel distributor warrants. Nevertheless, there seems to be no reason for government interference in this. Further, there seems no rationale to support arbitrary, artificial and unnecessary limits on the blend percentages that will be permitted. This is elaborated later, in the more detailed commentary on the question posed in the Government Paper and the recommendations in the appended Seddon & Assoc discussion paper.

Similarly, it is unnecessary, in principle, for individual specifications of the components going into a blend. An example: a consumer has no interest in eg the viscosity of the fossil or biodiesel that was used to make up a BXX, only that the final product is suitable (meets specification). Of course, the suppliers and blenders will have a significant interest, since making a final blend that does not comply carries substantial financial penalties, in further blending/re-processing, re-testing, associated holding and supply-delay costs. But these are commercial/technical issues, which do not require regulation and which market forces will determine.

From a regulatory perspective, consideration needs to be given to the minimum amount of testing that is required to ensure compliance of the final product and how this interplays with prior certification of the blend components. An example: fossil diesel contains essentially no glycerol, so provided the glycerol concentration of the biodiesel to be blended is known, the blend concentration is also known by simple material balance. If the biodiesel has been properly certified, the blend may be deemed to comply with specification without further testing. On this argument, particular certifications for purity or properties of blend components may be adequate also to certify blends. However, there will be properties that need to be certified on the final blend itself, if only to demonstrate proper mixing. I return to this important point later.

As a general principle, the regulatory requirements should be the minimum necessary to achieve their objectives in this case "…to facilitate the adoption of emerging vehicle engine and emission control technologies…" (p3 discussion document).

Preferably, they should be as flexible as possible so that artificial barriers to otherwise acceptable products are not imposed. Given that different countries have experience with different biodiesel feedstocks, we should seek to capture this experience and permit sufficient flexibility to allow incorporation of biodiesel standards or compliance testing standards that are accepted by other nations or suitable authorities. This should provide a means for not arbitrarily or inadvertently excluding satisfactory but currently unaccounted oil sources. Many 'unconventional' oils are being considered in various countries eg jatropha sourced biodiesel, where India and S. Africa are gaining experience; or coconut sourced biodiesel, from Philippines experience; or pongamia, or algal sourced oil, amongst many others, for which experience may arise in future. This is aligned with recent undertakings by the Prime Minister to ASEAN, to harmonize biodiesel regulations and facilitate uptake.

Commentary on options

B5 limit:
It is difficult to see any logical reason or even advantage to cap biodiesel blends at 5%.

The discussion about the upper density is an unnecessary side issue: (i) Refiners have a vested interest to make diesel having the lowest possible density (since the sale is by volume, lower density = higher price). Indeed, there are already waivers to the ***lower*** limit for some refineries – although one may observe in passing that the lower density/energy content is not reflected in the sale price. An aromatic limit would be more logical, would have a similar density outcome, and more aligned with the environmental objectives of the regulations; (ii) there is no upper density limit in the US and they seem to manage alright; (iii) biodiesels have a lower energy density than fossil diesel and consequently is desirable that this be compensated for by having a higher physical density.

Logically, if a fuel meets the diesel standard, then from a regulatory point of view, it is compliant for sale as diesel. The standards do not require that diesel be made from crude fossil oil (as would seem already accepted eg the BP Brisbane refinery uses tallow as a feedstock). In practice, major distributors would most likely be extremely wary of arbitrary compliant mixtures which do not meet in-house formulation rules, because of potential fit-for-purpose liabilities. On this basis a B5 may gain blanket approval from engine and component manufacturers, which would promote consumer take-up, but this is hardly a good reason for legislative interference in a free market economy.

Most manufacturers seem to accept that use of biodiesel in quite high blends will not void materials and workmanship warranties, although their positions in different countries often seem inconsistent. “Fuel warranties” are carried by the fuel supplier and OEMs will generally not accept liability from issues that arise from fuel related failures.

The discussion canvasses opinions about flexibility regarding quality parameters for blends. In particular, density (discussed above), viscosity, distillation, cold flow and stability specifications, are mentioned. Regarding viscosity, one may observe that the specifications for biodiesel and diesel are inconsistent. If the lower limit for fossil diesel is acceptable for engines, then that should also be the lower limit for biodiesel. Similarly, if the upper limit is acceptable for biodiesel, then it should be acceptable for fossil diesel. This discrepancy is further exacerbated by the fact that the standard relates to kinematic viscosity, while the property of interest from an operational point of view is better described by dynamic viscosity. The distillation specification is idiosyncratic to fossil diesel quality: it presents a good example of the inadequacy of the test methods when flexibility is required. These testing practices should, over a period of time, be replaced by modern, preferably fundamental, property methods. Cold flow properties will be discussed in more detail later. At this stage, suffice that cold flow capability obviously affects operability and should not be opportunistically changed to permit inadequate manufacturing processes or feed materials. Storage stability is an important issue since one environmental advantage of biodiesel is its biocompatibility and instability relative to diesel. A suitable specification range needs to be determined to reach a suitable balance of properties between longevity and degradability.

B20 limit:

The discussion about B20 again focuses on market entry and acceptance issues, which are the domain of the free market, not legislative regulation. There is no rational reason for a blend setting or even cap at 20% (or any other arbitrary value). I consider that it is technically feasible to make a B100 fuel conforming to the diesel specification (excepting possibly density). In general, the frameworks canvassed in this section of the report seem reasonable, provided there is no cap applied. This means either

(i) a comprehensive standard that applies to blends at any proportion of feedstocks that ultimately meet the specification (including eg synthetics, alcohols, esters, ethers, etc); or
(ii) the development of simplified standards for particular blends like diesel and (ester) biodiesel. These options could of course both be applied.

It must be recognized from a practical perspective (i) may take considerable time to reach agreement, except by accepting the current diesel standard (which effectively excludes most higher blends of biodiesel, except with waivers, because of eg the distillation specification). It would however open the door to non-fossil biodiesel/FT synthetic fuel blends, which could quite conceivably be made compliant with the diesel specification, but are totally untested in operation. Consequently, I consider only option (ii) is feasible in the immediate future.

Based on the discussion above, I support a simplified BXX standard, which includes blending diesel and biodiesel feedstocks to meet an ultimate blend specification. The percentage of the biodiesel (or other blend components) does not need to be regulated. The individual specifications of the biodiesel (or other blend components) do not need to be mandated. However, provided the feedstocks are certified to meet particular specifications prior to blending, then post blend testing may be simplified and some specifications may be deemed to be met without additional post blend verification. This is quite similar to the option proposed by Seddon and Assoc. (p38), but with a higher degree of flexibility as to when and where (ie before or after blending) the compliance testing and certification is done. The extent to which pre-blend testing is done is then left as a commercial decision by the blenders. Some quarantining of the feedstocks both preceding and after blending to permit analysis and certification of quality is inevitable and in any event a routine requirement for normal diesel release. With respect to post blend testing, I consider the suggestions in Table 1 "Suggested post blending parameters tests and values for B20" (p9) are unnecessarily repetitive. Most can be handled by an 'either-or' approach (individual specifications are met before blending ***or*** product specifications are met after blending), with only a minimal number of tests being mandatory post blend, to ensure proper mixing (eg biodiesel content) and any special final customer quality checks (eg filter blocking tendency, water) that may be considered necessary to assure the integrity of distribution.

Commentary on Seddon and Assoc. report (Standardizing biodiesel blends)

Desktop Literature survey

The remit for this was apparently for a B20 blend (a limit which I do not support), but the general content of the report can be extended to higher blends. The paper presents a broad and quite comprehensive survey, embracing (in accordance with its remit) a far wider range of issues that inform, but are not all necessary to include within, a regulatory standard. Many can be dealt with through normal industry practice codes or recommendations. Others provide useful guidance for blenders, eg the discussion on additives, or risks. Such guidance is often provided in standards, but is non binding, so I omit commentary on this here.

Table 1 is recognized in the report to be incomplete, but it is important to emphasize that any frameworks be as embracing as possible, so that future resources are not inadvertently excluded or discriminated against. As examples: Australia has quite a large avocado industry, which provides oil that could be suitable for biodiesel. (The value of this oil for other uses makes it commercially unattractive for biodiesel, but this can conceivably change). Also, algal oils have been proposed as very high yielding potentially viable sources of oil, but very little is known about how they will perform. The point is, we do not know what feed oils may become important in the future and tailoring the rules only for those we currently recognize is inadvisable. The US and European biodiesel standards have, to some degree, fallen into this unnecessary trap. Since the fatty acids in plant and animal oils suitable for biodiesel are relatively few and well defined, suitable biodiesel materials need not be specified according to origin, eg RME biodiesel, but rather by acceptable fatty acid components.

An important consideration for biodiesel is its propensity to increase NOx emissions. I consider that BXX blends into the market should be mandated to be NOx neutral (ie not increase NOx emissions above current diesel levels). This can be relatively easily accommodated in the short term using additives, or more preferably, by limiting the diesel aromatic content, or using appropriate biodiesel blends (eg including more short chain fatty acid feedstocks, such as from coconut oil). In the longer term, it could be

addressed by appropriate engine design or tuning. This would align with the stated main objective of the discussion paper and standard: "The principal reason … is an environmental one…" (p3).

For BXX blends there is much discussion related to cold flow properties. In my view, these are sufficiently dealt with within current diesel practice, which can be directly transposed to biodiesel blends. The logic that cold flow properties should be relaxed for biodiesel blends to accommodate tallow or palm oil feeds does not make sense: either the diesel specification is too restrictive (and should be changed) or the diesel specification is appropriate and relaxation will present operability problems. Property modifiers or appropriate choice of feedstocks for esterification can applied if necessary to assist biodiesels to meet the cold flow specifications.

Quality Analysis and test methods

General

There are serious concerns relative to the B100 biodiesel standard. While the standard itself is largely acceptable, with some inconsistencies which should be corrected[1], the supporting analytical test methods are unnecessarily restrictive and in many cases counter-productive. Many specifications are unnecessarily repetitive, eg flash point and residual alcohol content. Some tests are poorly (or more likely, obstructively) designed and prevent fuels which should logically comply with the specification from being shown conclusively (and legally) to do so. An example: The biodiesel ester content is to be measured according to the Australian standard using EN14103. EN14103 is unsuitable for FFA chains of <C14, so any feed oils with appreciable amounts of short chain fatty acids, for example coconut oil, cannot actually be shown to make compliant biodiesel according to a strict interpretation. In practical terms the actual testing for these shorter chains is quite straightforward and easily done in any competent laboratory, in ways which follow the methodology but not the precise prescriptive method in the standard. In fact, coconut oil biodiesel has many very desirable properties including good low temperature behavior, high stability and low viscosity amongst others, and can be easily made to comply with the biodiesel standard (although this cannot be proven using the approved test method EN14103). Similarly, the EN14103 test also requires C17 as an internal standard, which means that it provides a manifestly incorrect result for oils which naturally contain C17, importantly some animal tallow, consequently also making it technically impossible in these cases to correctly apply the standard method and therefore show compliance with the overall biodiesel standard. The use of ethanol or other alcohols is also not compatible with a number of the tests which refer specifically to FAME (fatty acid ***methyl*** esters). This illustrates how the fine detail of the specifications may have unwanted and perverse outcomes and demonstrates the importance of providing mechanisms for sensible accommodations that are not hostage to special interests.

BXX blends

Distillation: This test serves a useful purpose for crude oil based diesel but is inappropriate for biodiesel for reasons described in the report. My recommendation is an 'either-or' option: that BXX blends be certified based on ***either*** the post blend product meets the particular specification (eg the EMA recommendation) ***or*** the specification is met in both the diesel (through the Fuel standards determination for diesel, 2001) *and* the specification is met in the biodiesel (through the Fuel standards determination for biodiesel, 2003). This allows the flexibility for low level blends to be tested after blending if desired, but also provides a mechanism for certifying high level blends, by pre-blend certification. The specific details of how this should be managed needs to be broadly discussed and agreed, but as examples of properties that could be dealt with in an either-or fashion:

Sulfur; Lubricity; Cold flow; Viscosity; Density; Ash; Corrosion; Cetane; Carbon; Conductivity; Stability; Phosphorous; Flash point; Water; Cold flow (but no worse than current diesel requirements).

[1] eg viscosity limits and flash point should be aligned with the diesel specification.

Some post-blend testing should be mandatory, but much simpler than recommended by Seddon and Assoc (Table7, p57). I recommend:

- appearance (for water haze)
- ester content (eg EN 14078, to ensure proper blending). The development of a more general screening test for blend constituents is highly desirable.
- stability (eg ASTM D2274, since biodiesel may be held in storage for an unknown period post certification)
- acidity (eg ASTM D664, since biodiesel may be deteriorate in storage, post certification)

The other tests in Table 7 (p57) are unnecessarily repetitive and provide no additional information or value if the diesel and biodiesel have been certified for these parameters prior to blending.

Other tests: Many of the test procedures (and discussion) refer to FAME (fatty acid ***methyl*** esters). These are quite limiting and need to be expanded to include other alcohols. Similarly, some additives that might routinely be added in some cases invalidate some of the standard testing methods. These analytical integrity issues can cause serious problems for biodiesel manufacturers in getting their products certified and present technically unnecessary barriers for introducing valuable products to market.

Areas of certainty and doubt: This discussion relates to attempts to demonstrate the use of B20 in large scale trials. This is an important market issue with respect to building confidence or pressurizing engine manufacturers or fuel suppliers to accept higher biodiesel blends, and contains information useful also to inform blend standards. It seems likely that a high level biodiesel blend standard acceptable to manufacturers and suppliers will eventually emerge, driven by market demands (eg B20 if US is dominant; B30 if EU is dominant). However, given the small Australian vehicle market and harmonization requirements, Australian consumers will probably be followers in this regard. Currently, it is hard to see Australian consumers very broadly accepting blends that manufacturers recommend against (ie >B5), or oil majors carrying the (fit for purpose) risk of higher blends, without additional comfort from large scale testing, or a commercial advantage more compelling than currently exists.

Oxidative stability: Storage stability, if necessary, can be relatively easily addressed with additives. Some biodiesels, such as coconut biodiesel, are intrinsically more stable and probably do not require additives, while others having higher unsaturation may require treatment. If, as suggested, the product labeling advises use within a reasonable period of time, then longevity can be addressed through suitable technical options. One of the attractive features of biodiesel from an environmental perspective is that is susceptible to degradation and this benefit should not be turned into a disadvantage.

Labeling

It should be mandatory that consumers be informed of the product that they are purchasing, including the fact that the fuel contains biodiesel and the percentage. A B20 blend, for example, should NOT mean *any* percentage up to B20, rather a blend containing very close to 20% biodiesel (say ±2%). A consumer choosing biodiesel blend should get biodiesel blend, not maybe get! Low level blends, including B5 should also be labeled for the information of consumers, not treated as an undisclosed fossil diesel 'additive'.

Distributors may elect to provide standard blends (eg B5; B20; B30; B100), rather than arbitrary percentages of biodiesel, to facilitate their marketing and signage, but this is a commercial choice and need not be mandated. The CFPP of blends should conform to the normal diesel standard and so special labeling on this point is not necessary. The annotation to "change sump oil regularly" is too vague to be of any assistance to purchasers; the admonition to "check with your manufacturer…" should elicit proper, specific and more quantitatively useful advice. Subject to these comments, the labeling suggested by Seddon and Assoc (p76) seems appropriate.