INVESTIGATION INTO HARMONIZATION OF IBSA BIOFUELS SPECIFICATIONS AND STANDARDS

Birchwood Hotel, Johannesburg, South Africa
02 – 03 December 2010
Acronyms & Explanations

- **ANP** – Agência Nacional do Petróleo
- **BIS** – Bureau of Indian Standards
- **B5** – 5% FAME or B10 – 10% FAME (Standard Automotive Petroleum Diesel)
- **Denatured** – to make ethanol non potable.
- **E10** – this is a petrol blend containing 10% ethanol. E5 is thus a 5% blend
- **EPASA** – Ethanol Producers Association of South Africa
- **FAME** – Fatty Acid Methyl Ester (Biodiesel)
- **Feedstock** – this is the source material that will have differing processes for different feedstock
- **RVP** – Reid Vapour Pressure (ethanol & volatility)
- **IBSA** – India-Brazil-South Africa
- **IS15404** – Indian Biodiesel Standard
- **IS15607** – Indian Bioethanol Standard
- **MS573** – Malawian Standard for Ethanol
- **SABA** – Southern African Bioenergy Association
- **SADC** – Southern African Development Community
- **SANS 342** – South African National Automotive Diesel Specification – blending biodiesel with standard diesel to a max of 5% must not change the standards listed in SANS 342
- **SANS 465** – denatured ethanol used for blending with petrol
- **SANS 1935** – the current standard for biodiesel produced in South Africa based on European specifications
- **SANS 1598** – petrol specifications which allow for a maximum blending of 7,5% ethanol at the coast and 9,5% inland in the absence of any other oxygenates
- **UNDP** – United Nations Development Programme
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Exploring harmonisation of biofuels standards and specifications

The main purpose of this IBSA dialogue forum is to lay a foundation for opening and enhancing trade among India, Brazil and South Africa through biofuel standards

Welcome by the DoE & UNDP

Ms. Noma Qase, Director: New and Renewable Energy from the South African Department of Energy (DoE):
- Extended a warm welcome to workshop participants;
- Expressed sincere gratitude to UNDP for making the workshop a reality through its support; and
- Thanked all for coming to make sure that the signed biofuels Memorandum of Understanding (MoU) is implemented;

Ms. Helene Gichenje, Project Manager (Environment): UNDP Regional Service Centre for Eastern and Southern Africa thanked the South African government for choosing UNDP as a partner for the workshop. She further urged delegates to ensure that the workshop objectives are realised not only for South Africa but for the Southern African Development Community (SADC) as well.

According to Ms. Gichenje:
- Energy is an important component of achieving the millennium development goals and UNDP is working on a number of initiatives to ensure the improved energy access in developing countries; and
- The workshop is an important platform for sharing experiences amongst the southern partners something that is an important part of policy formation and implementation;

A detailed list of attendees is attached hereto.

Biofuels in general

The term biofuel is all embracing. Liquid biofuel covers the production of biodiesel, fuel ethanol and potable ethanol while each segment has its own challenges in terms of feedstock, production, taxation, storage and distribution. From an IBSA perspective ethanol is well-established and understood whereas biodiesel is in its infancy stages.

Fuel ethanol constituents

Ethanol is not new to South Africa – it has been blended into petrol for many years. Ethanol has been blended into fuel in India for a few years and in South Africa and in Brazil in excess of 30 years. Ethanol feedstock is derived from two streams, the plant families containing:
- Sugar;
- Starch

The chemical composition of ethanol is partly detailed in the fuel ethanol specifications.
Welcome by the Department of Energy (DoE)

This was the second workshop in terms of the Memorandum of Understanding signed for biofuels; the first workshop was in San Paulo, Brazil. Apologies were conveyed from the DoE Chief Director; Clean Energy, who was in Cancun. The only message is that the workshop should be conducted in a very productive manner such that we are able to provide a solid report on what has been done to date. For the benefit of all involved, our neighbours from the SADC states have been invited. The reason for that is that within SADC there is a strong focus on developing a biofuels program and it is important to harmonise within the member states. Therefore the biofuels standards and specs are not only of interest to IBSA, but also to the SADC community. These deliberations will have an impact beyond IBSA and hopefully filter into the international markets.

Challenges for the biofuels industry

Every speaker listed the challenges to be overcome. There are a number of similarities between the IBSA members.

Testing & enforcement

A successful biofuels programme rests on a very effective testing network, followed by visible enforcement. The Brazilian example for fuel includes 5000 samples of diesel, gasoline, ethanol and biodiesel taken every month covering 46,000 distribution points. There are also testing requirements for every retail fuel service station. Although quality assurance programmes are expensive, especially for small manufacturers, they are essential to ensure consistency and conformity.

South Africa’s ethanol experience

SASOL has been blending ethanol into petrol for over 20 years – to a level of 2%. SASOL ethanol is synthetic and not bioethanol. Aligning all these complex and detailed constituents is a compatibility challenge for India, Brazil and South Africa.

Potable ethanol

In South Africa the illicit trade in bioethanol runs into hundreds of millions of Rands in evasion of taxable excise duties. A suitable denaturant must be added to ethanol to make the taste too bitter and unpleasant for human consumption. Brazil also adds an orange dye to the anhydrous ethanol that cannot be removed.

Ethanol and water

All papers presented at the workshop emphasised the importance of excluding moisture and testing for water secondary constituents. Absolutely dry storage and transport systems are required as ethanol is infinitely soluble in water and hygroscopic. The absorption of too much water with temperature changes and the level of ethanol blend can result in ethanol being separated completely out of the gasoline with consequences for engine combustion processes.

South Africa typically suffers from an enduring lack of contamination control in the distribution and storage of petroleum products. This current lack of hygiene goes against the grain of strict control over ethanol hygiene and underscores the need for effective testing and enforcement.

Ethanol and energy

The kilogram per kilolitre comparison between petrol and ethanol is as follows:

<table>
<thead>
<tr>
<th>1kg Petrol</th>
<th>1kg Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>43 GJ</td>
<td>27 GJ</td>
</tr>
</tbody>
</table>

It follows that fuel consumption will increase to counterbalance power loss. While this has been estimated at a maximum of 1,5% increase in fuel consumption, the number of variables involved in fuel usage combined with slow speed traffic conditions, makes the fuel increase issue a minimal factor.

Ethanol and volume

When it comes to blending one plus one does not equal two. Adding 100 litres of ethanol to 900 litres of petrol results in 1,004 litres of fuel – this is due to molecular changes occurring in the mixture. On the other hand the coefficient of expansion factor does not change significantly for blended fuel versus standard petrol.

Ethanol specifications

The differences between India, Brazil and South Africa have been historically based. As a result of this there are fundamental differences in certain parameters and standards based on the processing and distribution chain logistics as well as plant design.

Ethanol and volatility

Addition of even moderate levels of ethanol results in a sharp increase in volatility of the base petrol, expressed as the Reid Vapour Pressure (RVP). Adding ethanol can thus result in a distortion of the distillation curve. This affects vehicle driveability. A special base-stock is thus required when blending ethanol to ensure volatility compliance and fit-for-purpose product.

Biodiesel constituents

Biodiesel consists of Fatty Acid Methyl Ester (FAME), glycerol, poly-unsaturates and other secondary constituents such as calcium, manganese and potassium. In South Africa there are 26 properties that define the quality of biodiesel.

South African biodiesel feedstock is derived from two streams

- The waste oil streams – mainly plant oil used in cooking; and
- Pure plant oil.

Biodiesel and water

Water must be set as a minimum standard as it encourages the growth of micro-organisms, and microbial activity that damages fuel storage facilities.

Biodiesel and stability

Biodiesel is inherently unstable as it is bio-degradable and therefore housekeeping and stock management is critically important.

Biodiesel specifications

The IBSA countries are fairly aligned on biodiesel specification as they are all based on the European B100 standard (EN14214).

Farooq Zaidi, Associate Vice President: PRAJ Industries Ltd: The Overview of the International Bioethanol Specifications and Standards.

Zaidi focused on bioethanol specifications and standards giving some global perspective. There needs to be some basic level of standardisation to ensure seamless utilisation of resources across the countries and continents, with all stakeholders working as one community.

The cycle of biofuels is demonstrated in figure 1.1 below where the client wants to buy and the producer sells product; however analysis and conformity is required to ensure that the cycle is kept in balance.

The major specifications of the 5 major ethanol regions (Brazil, Europe, USA, South Africa and India) are the minimum ethanol content, acidity, PHe and chloride (from water quality) and sulphur, which differ among the regions. Chloride and acidity are important as they contribute to corrosion.

The specifications are driven mainly by the trade routes/channels which are from Brazil to EU, US to EU and Brazil to US. The trade client expectations are typically ethanol content 99.4%, water content of 0.6% weight maximum, which is critical depending on the blend of ethanol in final fuel as it affects the ability to handle water (moisture). There needs to be a stepwise approach to Quality Assurance, being:

Production
- Process modification for each component: pH, sulphur, water, chloride and ethanol content, etc.
- Loss of production – water content (10% to 22%).

Process Control
- Control Logic to control variables at process (distillation) to obtain ethanol in specifications.
- Analytical Laboratory to ensure product conformity.
- Manpower Training for smooth process & analysis.

Storage in the Producer Site
- Separate tank for different products.
- Independent lines to and from tanks.

Transportation
- Trucks, railroad cars must be cleaned to prevent contamination
- Pipeline – Prevention necessary to avoid cross contamination.

Storage in the Port
- Segregation in the tanks exclusively for ethanol.
- Prevention of contamination in pipes during loading.
- 700 to 900 parts per million (ppm) of moisture is gained when shipping for 10 days at sea.

Shipment
- Cleaning of the ship tanks – contamination tests.
- Cleaning of the connection pipes to ship.
- Quality checks/maintenance during voyage.

Quality Assurance - Analytical control
- Quality has to be known to guarantee the specification from the producer to the shipment.
- Validated methods for the specific matrix.
- Laboratory instruments to measure the quality according to the specification.
- Equipment calibrated and validated.
- Trained technicians to perform the analysis.
- Reliability of the measurement – repeatability, reproducibility, uncertainty.
- Certified Reference Material.
EPASA
The Association is made up of 5 members where ethanol is made by fermentation (from molasses) and from coal, which is classified as synthetic.

The current fermentation capacity is equivalent to the first planned fuel ethanol plant in South Africa. In terms of disposal of the product – the major usage is conversion into ethyl acrylate and ethyl acetate manufacture, with the fermentation of about 22,000 kilo liters (kl) into the liquor industry. The country is relatively a large exporter (≈50% of production).

Denaturing of fuel ethanol is essential to ensure that it does not enter the potable markets.

Need to consider:
- standardisation via the SADC Cooperation in Standardisation (SADCSTAN) as South Africa partly supplies 5 of the 14 SADC countries
- Zimbabwe project: 100,000 kl/a
- Mozambique project: 150,000 kl/a
- Nomenclature: the term Fuel ethanol, should be used

The SADC region has a number of distilleries, but only 2 countries are incorporating ethanol into fuel. Malawi used to use E20, but has switched back to E10 when moved to unleaded petrol in January 2006. Malawi has its own standard MS 573 and recently proposed that the SADC countries standardise on their standard; this was not supported.

In South Africa the current legislation permits the addition of ethanol into petrol and Sasol have been including ethanol for some years at a very low level. The SANS 465 applies in SA, and is currently under review. The working group has adopted two principles, combining the American and European Union standards with denatured and un-denatured products, also taking into account the current South African standard.

The parameters that are gaining attention are:
- Denaturant – is petrol an adequate denaturant?
- Water level at a 2 to 5% blend ratio
- Methanol
- Solvent washed gum
- Total sulphate

The following are concerns:

Once the SANS 465 is re-issued, we may request harmonisation of the standard in the SADC region. There is a concern regarding the slow implementation of the biofuel strategy in South Africa, where commercial aspects appear to be the obstacle.

Discussions:

Q: Why are denaturants required in RSA? Brazil does not use denaturant.
A: There is a distinct need as the product moves from the distillery to the blend plant, and this could possibly be extracted. The country is facing a problem with illicit liquor trade as the excise duties in the country are in excess of R3.5 billion annually; this needs to be protected. International experience – supply un-denatured with strict control and any losses carry the excise duty – this is high. In South Africa the illicit trade is difficult to quantify, but it is currently estimated at R 350 million per annum in terms of excise duty.

Q: Can pipeline not be used?
A: The ethanol production will be in rural areas and these distances are large.

Q: RSA have a basis of duty being paid at source, properly denatured product. Would South African Revenue Service consider duty removal? What is the International experience?
A: In India, the experience is that duty is applicable at source and the product is denatured as it needs to be transported by road from the rural distilleries to the blending location.

Q: To what extent does the feedstock affect the properties?
A: 2 families of feedstock: first being one that contains sugar and second family is grain. This does impact the quality due to the chemicals used in the process. However with the current technology, all of these aspects can be controlled. Conformity of product can be a problem, but can be handled. Grain varies around the world and this does have an impact, but can be handled at the product stage.

Q: The specifications need to be developed with the vehicle parc and requirements in mind and the logistics available in the country.

Q: The 1% water spec in India; is that acceptable with low blending ratios?
A: Information was shared with regards to the water handling ability; it plays a major role at 1-2%. The typical water content is 1 to 2000 ppm.

Q: Why are the differences in ethanol allowable between in land and the coast?
A: This is due to the altitude and differences and the impact is leaning out the combustion.

Q: What is the impact of volatility with ethanol blending?
A: The industry has taken note of these issues. The United Kingdom Petroleum Industry Association (UKPIA) is looking at increasing the vapour pressure from 60 to 70. The current South African specification applies at 70 kPa with ethanol in fuel.
Blegenhout focussed on the overall biodiesel specifications and what drives them, namely:
- Climate
- Available feedstocks
- Politics (geo, national and regional/provincial)
- Social (& labour skills)
- Technology (Process, Vehicle and Lubricants)
- Economics (geo, national and regional/provincial)
- Distribution chain

All the above fit together to drive a specification that is fit-for-purpose to ensure safety and reliability of machinery and minimise harms to the environment (including people).

Among the current feedstocks are:
- Rape Seed / Canola
- Soy bean oil
- Palm oil
- Coconut
- Sunflower
- Jatropha
- Animal fats / Tallow
- Used Cooking oil

The key differences in the specification are in the glycerol content; this is partly due to the specific feedstocks. The properties as indicated in figure 3.1 below need to be balanced to be able to achieve market related performance product.

The Association’s view is that 5% blending for biodiesel and 10% for ethanol is achievable. However a captive fleet solution is required with different blending ratios in different regions to reduce transport costs, rather than for a whole national role out.

It should be noted that the household spending on transport is significantly higher than that of electricity. There is a wide variety of different fuels used in transport, and the real reason for biofuels, besides job creation is reduction of emissions. Greenhouse gases (GHGs) can be reduced with technologies, but come with a cost.

Biofuels therefore have a cost-effective role to play.

The major product related market is used cooking oil and hydrous ethanol. There are 10 million tons of waste streams annually in South Africa.

The increase in diesel consumption is higher than the petrol consumption in the Southern African markets. Refined products are therefore imported. Biofuels can substitute these imports specifically with regards to pricing issues.

Standards are required for Jet, Illuminating Paraffin, ethanol and ethanol gel as a household fuel.
Indian biofuels program

The programs are supported by the Government and in underpinned by pricing and feedstock availability.

India announced a biofuel policy in December 2009, and that ONLY domestic ethanol will be used for fuel. With regards to the food versus food debate, only non-edible oils will be used, therefore research and development is being focussed on Jatropha Curcas and Karanja. Further only waste lands can be used for this production.

Brazilian bioethanol program

Brazil has a wide variety of feedstocks to increase its energy supply (currently 47% is renewable) but relying on diversity and availability of natural resources. This plan increases according to the projections up until 2030. The biofuel program has been a Governmental program that has been incentivised, from the early 1970’s. The blending levels are mandatory at 85 and E 20-25 (anhydrous).

Part of the ethanol is transported by dedicated pipelines. The colour is not a quality parameter for ethanol. A very small amount of certain impurities can be used to colour ethanol, although there are no specifications to be taken into account.

The Government has promoted the use of biofuels. India consumes approximately (≈) 50 billion litres of diesel and ≈10 billion litres of petrol annually. Therefore biodiesel in considered to be more important than fuel ethanol and India has been pursuing its use since 2003. In 2006, a Government 5% bioethanol program in India was rolled out. The ethanol volume has grown from 560 million litres to ≈800 million litres today.

There were problems in procuring the required volume of ethanol, which is manufactured from molasses, as there is a demand for potable and chemical purposes, which has been increased now for fuel as well. The fixed purchase price for fuel ethanol has been increase (5-6 Rupees per litre increase); the industry has stated that they could supply 1 billion litres of ethanol for fuel purposes.

India announced a biofuel policy in December 2009, and that ONLY domestic ethanol will be used for fuel. With regards to the food versus food debate, only not edible oils will be used; therefore research and development is being focussed on Jatropha Curcas and Karanja. Further only waste lands can be used for this production. There are biodiesel processing plants are available, but there is a lack of feedstock.

Biodiesel Specifications

Pertaining to the specifications (IS15404), they have been adopted with the view that only non-edible feedstocks will be used. It is based on ASTM and European standards. The term ‘Bio-diesel’ refers to mono alkyl (methyl or ethyl) esters of vegetable oils like Rapeseed, Soya bean, Sunflower, Jatropha Curcas, Karanja, etc, and other fats.
- Biodiesel shall not contain any residual oil.
- Biodiesel specified shall be mono-alkyl esters of long chain fatty acids from vegetable oil and animal fats.
- Dyes or markers are allowed to be used for the purpose of identification.
- Material shall also comply with the listed requirements

Biodiesel has not been marketed thus far in India.

Bioethanol Specifications

Anhydrous ethanol (IS15607) was finalised in 2004.
- Anhydrous ethanol shall be a clear, colourless and homogeneous liquid, free from matter in suspension.
- The denaturant to be admixed with ethyl alcohol and the proportion in which it is to be used shall be as prescribed by law from time to time.
- Subject to the effect of the added denaturant, anhydrous ethanol shall comply with the requirements for general purposes prescribed for ethyl alcohol.
- The material shall be neutral or acidic in reaction to phenolphthalein and when tested.
- The material shall also comply with the requirements as supplied

Note that there is NO mention of water concentration in the standard – this is because of the purity requirement of 99.50% ethanol.

Brazil has a wide variety of feedstocks to increase its energy supply (currently 47% is renewable) but relying on diversity and availability of natural resources. This plan increases according to the projections up until 2030.

Biofuel is regulated as follows:
- A fuel produced from renewable biomass for use in internal combustion engines or, in accordance with regulations, for other types of energy generation, that could partially or totally replace fossil fuels, (Law11,097/2005)

It is important that jobs are saved and the GHG emissions are reduced. There are 422 ethanol plant registered with ANP, most in the South West region.

Dr HL Sharma

India

Maria Inês Souza, ANP - Brazil
Flex-Fuel vehicles were introduced in 2003, being able to operate on ethanol and gasoline, and this has been expanded to motorcycles as well. It is important that biofuels is only planted in suitable areas and that the Amazon is protected. The main fuel today for the light vehicles is ethanol, with more than 30 years of commercial use.

The total production is around 26 billion litres in 2009/10; this has increased because of the Flex-Fuel technology. There is a consolidated production and supply and this is being expanded to other heavy vehicles and airplanes (test) as well.

New specifications for premium ethanol have recently been issued, as are indicated in table 6.1. The premium ethanol has higher ethanol content and will be sold through a special pump, giving the customer choice. Tax differences are an issue and hence the anhydrous ethanol needs to be dyed.

The ethanol is regulated once it leaves the product plant and is controlled through the supply chain. It needs to be supplied through a distributor and not directly to the service station.

**Quality control**
The producer quality is controlled and they must be registered with ANP. Samples need to be retained for at least two months. The Quality Control Number needs to be on ALL documentation. They also need to send all the analysis of all the ethanol on a monthly basis so that this can be monitored. The wholesaler must ensure quality before delivering to the retail market. The following properties must be tested:

- **Hydrated ethanol:** Aspect – visual colour, Density and Alcohol content
- **Gasoline (E25):** Aspect – Visual colour, Density and ethanol content.

### Table 6.1 - Specifications

<table>
<thead>
<tr>
<th>Property</th>
<th>Units</th>
<th>Anhydrous</th>
<th>Hydrated</th>
<th>Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density at °C</td>
<td>kg/m³</td>
<td>max. 791.5</td>
<td>807.6 to 811.0</td>
<td>799.8 to 802.7</td>
</tr>
<tr>
<td>Alcohol content at 20°C</td>
<td>%/v</td>
<td>min. 99.6</td>
<td>95.1 to 96.0</td>
<td>97.1 to 97.8</td>
</tr>
<tr>
<td>Ethanol content, min</td>
<td>%/m</td>
<td>min. 99.3</td>
<td>92.6 to 93.8</td>
<td>95.5 to 96.5</td>
</tr>
<tr>
<td>Water</td>
<td>%/v</td>
<td>max. 0.4</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Acidity</td>
<td>mg/L</td>
<td>max. 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>µS/m</td>
<td>max. 350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg</td>
<td>max. 0.07</td>
<td>6.0-8.0</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/kg</td>
<td>max. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washed gum</td>
<td>mg/100 mL</td>
<td>max. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td></td>
<td>Clear &amp; No Impurities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td></td>
<td>Orange (dye) or cannot contain dye</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methanol</td>
<td>%/v</td>
<td>max. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>%/v</td>
<td>max. 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue by evaporation</td>
<td>mg/100 mL</td>
<td>max. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>mg/kg</td>
<td>max. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphate</td>
<td>mg/kg</td>
<td>max. 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>mg/kg</td>
<td>max. 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Most of the product is moved via multi-product pipeline from 6 refineries, with most of the fuel depots being based in the urban areas. It should be noted that one of the drivers for biofuels in South Africa is job creation, especially in rural areas.

Some of the areas that are earmarked for growing crops are in the Eastern Cape, Free State and KwaZulu Natal – hence there are long and complex supply chains. Therefore the specifications need to be tightly controlled from the manufacturer to ensure that the product at the end consumer level is fit-for-purpose.

Some of the challenges are:
- Denaturant
- RVP (differences between coast and inland)
- Long and complex distribution chains
- Fuel storage limitations (additional tankage requirements)
- Water content (with respect to driveability)
- History of alcohol in the past.

The South African Bureau of Standards (SABS) technical committee is at the first draft stage of updating the specifications. The committee is looking for guidance with respect to the denaturant that should be used – possible petrol. The South African specification has drawn from the US and EU standards.

With regards to Volatility (RVP): When ethanol is blended into gasoline, a number of properties are affected, including:
- Vapour pressure
- Water solubility
- Material compatibility
- Oxygen content
- Octane
- Distillation properties
- Energy content (fuel economy, power; ≈70% of gasoline)

Although the RVP for ethanol is very low, in comparison with gasoline, it does not blend linearly. This is because ethanol is a very polar substance, and is affected when blended, increasing the RVP. This also affects the blending volume resulting in a 0.4% (max) volume increase. This is indicated in the diagram below. It needs to be taken into account when blending and a special blend is required to ensure that the specifications are not exceeded.

The distillation curve is also affected, as the ethanol boils at approximately 78°C. This affects other properties, such as the FVI (Flexible Volatility Index) and hence driveability.

**Discussion**

**Q:** What impact does the RVP have?
**A:** It impacts driveability and higher levels of vapours are released during storage.

**Q:** Is it necessary to make any changes to the ethanol specifications for South Africa?
**A:** This needs to be looked at from a vehicle parc perspective and look at where the vehicle parc is going and take the standards from these requirements and not the fuel manufacturer’s ability.

**C:** The level of blending of ethanol is important when blending at different levels.

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![Diagram showing RVP and ethanol effectiveness](image)

**Source:** SABS

*Addition of 10% E85 gives 20% increase in E70 even though E85 boils at 78°C.*
The biofuels specification in South Africa is governed by the Petroleum Products Act, which enacts the following national standards:
- SANS 1935 – Automotive Biodiesel
- SANS 833 [Draft] – Biodiesel Production – Quality Management System

Based on the European Standard EN 14214 – the major difference is the Iodine Number to accommodate Soy Biodiesel. This is a B100 specification that can be blended at a 5% ratio for automotive diesel. Higher levels are allowable with labelling requirements. The manufacturers and wholesalers are controlled by Government. To assist the manufactures, quality guidelines have been put in place for frequency testing, with the idea to reduce costs, while ensuring quality.

There are currently 26 parameters that form part of the standard with approximately 13 parameters that are required from a fit-for-purpose perspective for the current vehicle parc. These levels have been set for the vehicle parc and backed up with international field experience.

The issue is where the tests can be conducted, as the cost is high, but required to mange a quality assurance program.
- SA has great specifications to ensure fit-for-purpose production and distribution
- Aligned to Europe, where our fleet largely originates
- Work needs to be conducted on differing feedstocks
- Specifications must be practical, cost-effective, enforceable and implementable

**Discussion**

**Q:** B20 standard is available in the US (ASTM); this is based on performance for vehicles and not production and feedstocks. Is something that should be considered?

**A:** The vehicle parc is fundamentally different between the US and EU – also, the fuel distribution systems are different to what we have in South Africa, where certification happens. The certification system needs to be defined.
BIO DIESEL CHALLENGES IN BRAZIL

Elimination of technical barriers is vital for sustainable biofuels in the world market.
- Acceptance of the biofuels in the market depends on transparency and trustworthiness of the fuel which should be obtained by standardization;
- Development of consistent terminology and reference materials;
- Depeining of standards harmonization has to take into account essentially the development of world test methods appropriate for fuels from different sources, limits of properties wherever possible and also be consistent with different engines.

To improve the international cooperation so as to achieve a sustainable biofuels market as well as to ensure the consolidation of ethanol and biodiesel as commodities.

B2 was made mandatory in 2008. This is now B5 which is equivalent to 2.4 billion litres per annum. ANP authorises the whole chain, including:
- Construction authorisation
- Operation authorisation
- Marketing authorisation.

Only then can they sell the product. The refinery buys the biodiesel in the auctions. Only distributors and refineries authorised by ANP can blend biodiesel to the fossil diesel.

There is a market demand to develop a B20 specification – working with the automotive industry, this is being developed. This is still under test; hence it cannot be sold as yet. The oxidation stability is going to be 20 hours for the B20 specification. There are currently 38 certified labs that have to be used for certification.

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anser</td>
<td>%</td>
<td>0.02</td>
</tr>
<tr>
<td>Cet</td>
<td>%</td>
<td>0.50</td>
</tr>
<tr>
<td>Massa Especifica (20°C)</td>
<td>kg/L</td>
<td>830.0</td>
</tr>
<tr>
<td>Viscosidade a 40°C</td>
<td>mm²/s</td>
<td>2.0 ± 4.5</td>
</tr>
<tr>
<td>Teste de Biocombustível</td>
<td>% volume</td>
<td>5.0 ± 2.0</td>
</tr>
<tr>
<td>Esteres, máx</td>
<td>mg/kg</td>
<td>10</td>
</tr>
<tr>
<td>Destilação / 5% vol</td>
<td>°C</td>
<td>180.0</td>
</tr>
<tr>
<td>Destilação / 52% vol</td>
<td>°C</td>
<td>240.0 ± 25.0</td>
</tr>
<tr>
<td>Destilação / 98% vol</td>
<td>°C</td>
<td>Anser</td>
</tr>
<tr>
<td>Destilação / 99% vol</td>
<td>°C</td>
<td>Anser</td>
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</tbody>
</table>

Discussion

Q: With different specifications from different sources – how do you manage the differences?
A: It is controlled on cold flow properties and sent to the different regions. There is a concern with bioactivity and hence deposits are formed.

Q: With regards to the standards – are they designed for the Automobile industry?
A: Joint studies were conducted in Brazil

10 Sara Prins, Manager: Strategic Research & Development, NMISA: Cost Efficient Biofuels Testing – International Best Practice

When we need to test something, we perform a measurement. The measurement needs to be traceable to the Système International (SI), which is the International System of Units. Moving forward, it is important to:
- Ensure international alignment of SANS with other standards, while meeting national requirements.
- Provide accessible, easy and affordable quality control (QC) methods for especially small biofuel producers.
- Establish International comparison (all parameters) between National Metrology Institutes (NMIs) to establish comparability and identify areas that require analytical support.
- Provide a range of Certified Reference Materials (CRMs) – especially for biodiesel.
- Improve communication between all stakeholders in SA

Cost-efficient biofuel testing
- Well defined and agreed parameters
- Traceable accurate measurement methods
- Fit-for-purpose methods
- Validated methods
- Certified reference materials

Measured once, accepted everywhere through metrological traceability and accredited testing facilities.

Discussion

Q: How can we take this forward into speeding up the test procedures and methods – is there correlation with the physical characteristics?
A: We need some samples and we can develop and compare.

Q: Are there some tests that are quick for the small plants for quick checks?
A: We need industries input into these aspects; expert forums can be put together.
The drivers for biofuels are really around CO₂; however it is rather about the changes in the vehicle parc. This is going to happen through engine technology, fuel efficiency, and biofuels are in the fuel mix, from a CO₂ perspective.

The vehicle parc is very diverse in vehicle technology and hence the fuel has to be fit-for-purpose for the whole vehicle parc (very old and new).

The biofuels needs to be blended into the traditional products, sourced from coal, gas and crude. The interaction of the traditional and bio-fuels needs to be understood for our unique situation, in a fungible (co-mingled) supply chain. Specifications are therefore required through the whole supply chain.

The other environmental and fit-for-purpose issues need to be taken into account as well. The automotive manufactures are looking for harmonisation around the world so that vehicle technology can be launched in different parts of the world.

There are 13 critical properties to be tested on a batch basis and an additional four to be tested regularly for biodiesel.

Ethanol is not new to South Africa, and some lessons have been learnt. The critical specs are considered to be the denaturant, corrosion, elastomer compatibility and volatility perspective. Also ethanol content (energy), methanol, solvent washed gum, water, inorganic chloride, copper, sulphur and appearance.

Volatility requirements, specifically at altitude, need to be considered in terms of ethanol and the base stock that is required to ensure security of supply.

Lastly the test methods need to be expanded to all feedstocks and become quicker and more cost effective over time.

The world is committed to sustainability of biofuels. For this to happen there was support from the automotive industry. Countries establish domestic sustainability criteria which shall be respected by national biofuel producers.

Efforts should be made in order to avoid unilateral criteria that could hinder biofuels trade and multilateral initiatives should be favoured in order to arrive to voluntary international criteria, which would contribute to harmonization.

Brazil working together on harmonisation in the short medium and long term – this can be expanded especially for fuel ethanol. Biodiesel does not appear to be too much of a problem.

A working group needs to be established. Then it needs to review all the specifications and harmonise the units and then decide what can be harmonised in the short, medium and long term. They need to take into account the difference in end-use, the difference in raw materials and the legislative requirement.

Inter-laboratory programs for fuel ethanol and biodiesel can be implemented to evaluate the ability of the laboratories in each country, identify analytical problems and apply corrective action. This will also provide additional credibility to the laboratories. This is a partnership between different sectors on the chain, as is indicated below.
The discussions were focused on harmonizing specifications from a trade perspective. This would enable the importation of biofuels amongst the regions. From this perspective there would be local specifications that will not impact trade, but can be handled within the import country.

As part of this the specifications need to be categorised in terms of differences in the current standards; these are outlined below:

### Category A
- **Similar**
- **Significant differences**
- **Fundamental differences**

<table>
<thead>
<tr>
<th>Category B</th>
<th>Category C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aromatics</td>
<td>Water – Harmonise with notes / ranges</td>
</tr>
<tr>
<td>Sodium</td>
<td>Ethanol Concentration</td>
</tr>
<tr>
<td>PH</td>
<td>Gums</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Chloride</td>
</tr>
<tr>
<td></td>
<td>Copper</td>
</tr>
<tr>
<td></td>
<td>Methanol</td>
</tr>
<tr>
<td></td>
<td>Acetic Acid</td>
</tr>
<tr>
<td></td>
<td>Acidity</td>
</tr>
<tr>
<td></td>
<td>Alcohol</td>
</tr>
<tr>
<td></td>
<td>Aldehydes</td>
</tr>
</tbody>
</table>

### Biodiesel

<table>
<thead>
<tr>
<th>Category A</th>
<th>Category B</th>
<th>Category C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar</td>
<td>Significant differences</td>
<td>Fundamental differences</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Viscosity</td>
<td>Ethanol</td>
</tr>
<tr>
<td>Density</td>
<td>Cetane</td>
<td>Cold flow</td>
</tr>
<tr>
<td>Carbon residue</td>
<td>Monoglyceride</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Di glycerides</td>
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<tr>
<td></td>
<td>Triglycerides</td>
<td></td>
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<tr>
<td></td>
<td>Glycerol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Linolenic acid methyl ester</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polyunsaturated methyl ester</td>
<td></td>
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</tbody>
</table>

This can then be worked out further by a technical specialist team represented by each of the regions.
**Issues to be considered:**
- Standardisation makes good business sense;
- Possibly there is a need for more than one standard with regards to biofuel standard for different applications;
- Denaturant;
- Volatility - Vapour pressure (RVP) and E70 (distillation);
- Logistics chain and location of biofuels plant versus the refineries and the market;
- Cost effective test methods;
- We need to looks at standardising with the regions with surplus ethanol, i.e. we need to give consideration to the American Society for Testing and Materials (ASTM) specification as well;
- We need to consider expanding this to hydrous ethanol as a transport fuel;
- Additional standards will need to be considered at a later stage;
- There is a need to collaborate more on the lessons learnt in the introduction in biofuels.
- Security of supply is critical when ethanol is introduced into the market as it cannot be pulled in and out of the market easily.
- The lessons learnt need to be disseminated through the whole industry.

The next steps are as follows:

<table>
<thead>
<tr>
<th></th>
<th>What</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Circulate notes and specification tables</td>
<td>SA (DoE)</td>
</tr>
<tr>
<td>2</td>
<td>Share test methods procedures</td>
<td>BIS, ANP, SABS TC 1018</td>
</tr>
<tr>
<td>3</td>
<td><strong>Form a workgroup</strong> on test procedures and standards (technical) – with representatives from each member (ANP, India and SABS technical Committees)</td>
<td>BIS, ANP, SABS TC 1018</td>
</tr>
<tr>
<td>4</td>
<td>Determine test procedure differences</td>
<td>BIS, ANP, SABS TC 1018</td>
</tr>
<tr>
<td>4</td>
<td>Harmonise trade specifications</td>
<td>BIS, ANP, SABS TC 1018</td>
</tr>
<tr>
<td>5</td>
<td>Program for reducing test cost?</td>
<td>BIS, ANP, SABS TC 1018</td>
</tr>
<tr>
<td>6</td>
<td>Program for extending feedstocks (tests)</td>
<td>BIS, ANP, SABS TC 1018</td>
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</tbody>
</table>
Overall

It was not all hard work, as there was fun over dinner and traditional music and dancing. A great relaxing end to a busy day:

On Day Two the workshop was closed by Ms Noma Qase, who thanked all the Indian, Brazilian and SADC colleagues who engaged and participated. Hopefully there will be more South Africans at the next workshop in India in terms of finalising the terms of reference.

The day and a half workshop was very technical and informative. The real identity is important and it must be clear that we are talking about fuel ethanol. There were lots of commonalities and the differences are not too big. All the members have shown the willingness to move forward and converge. We all recognise that we are not doing this for our own purposes, but that we are opening trade. We are looking forward to the outcomes of the workshop taking a step in this direction. The technical teams are encouraged to work speedily to reach agreement. The inter-laboratory program is a great idea and hope that we continue to work together to make this happen.

Thanks for the frank and open discussions around the biofuels topic and that these need to continue.
<table>
<thead>
<tr>
<th>Attendee</th>
<th>Position/Role</th>
<th>Location</th>
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<tbody>
<tr>
<td>Mandla David Vilakati</td>
<td>Ministry of natural resources and energy</td>
<td>Swaziland</td>
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<tr>
<td>Rapahael Tirivahu</td>
<td>Director, energy conservation and renewable energy</td>
<td>Zimbabwe</td>
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<tr>
<td>Helio Neves</td>
<td>Mozambique</td>
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<tr>
<td>Farooq Zaidi</td>
<td>Associated vice president: PRAI Industries Ltd</td>
<td>India</td>
</tr>
<tr>
<td>Alf Stevens</td>
<td>Secretary: EPASA</td>
<td>South Africa</td>
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<tr>
<td>Timothy Blegenhout</td>
<td>Chevron</td>
<td>South Africa</td>
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<tr>
<td>Erhard Seiler</td>
<td>SABA</td>
<td>South Africa</td>
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<tr>
<td>Maria Inês Souza</td>
<td>ANP</td>
<td>Brazil</td>
</tr>
<tr>
<td>Sara Prins</td>
<td>Manager: Strategic Research &amp; Development(NMISA)</td>
<td>South Africa</td>
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<tr>
<td>John Fitton</td>
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<tr>
<td>Nosisa Garane</td>
<td>SANERI</td>
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<tr>
<td>Abbey Mannganye</td>
<td>HUMELANI</td>
<td>South Africa</td>
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<tr>
<td>Thuthukile Mosia</td>
<td>CEF</td>
<td>South Africa</td>
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<tr>
<td>Jayne De Vos</td>
<td>NMISA</td>
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<tr>
<td>Bobby Moroe</td>
<td>DIRCO</td>
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<tr>
<td>Nomawethu Qase</td>
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<td>Azwifaneli Mukhithi</td>
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<td>Lebogang Morudu</td>
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<td>Lerato April</td>
<td>DoE</td>
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<td>Dianah Nangammbi</td>
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<td>Khanyiso Zihlangu</td>
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<td>Mpho Mabaso</td>
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<td>Mpho Nenweli</td>
<td>UNDP</td>
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<td>Neville Murray</td>
<td>Biodiesel Centre</td>
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<td>Themba Tsela</td>
<td>Menelisi Consulting</td>
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<tr>
<td>Derrick Gideons</td>
<td>EFLAMI Bioethanol</td>
<td>Swaziland</td>
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<td>Fernando Sena</td>
<td>Embassy of Brazil</td>
<td>South Africa</td>
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<tr>
<td>Gustavo Rosas</td>
<td>Head Of The Science And Technology, Energy And Cultural Sections</td>
<td>Brazil</td>
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<td>Koshka Janse van Rensburg</td>
<td>SABA</td>
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<td>Francios Labuschagme</td>
<td>PSS Oils</td>
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<td>Molefi Motuku</td>
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<td>Zibele Sokabo</td>
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<td>Raymond Abraham</td>
<td>SHELL</td>
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<td>Zombango Nondabula</td>
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<td>Naledi Seangeng</td>
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<td>Mpho Motloung</td>
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<td>Ndihuwo Mavhungu</td>
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<td>Magdeline Rasego</td>
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<tr>
<td>Reggie Shelembes</td>
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<td>Mokomane Mekgoe</td>
<td>DLG&amp;H</td>
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<td>Mashudu Sinthumule</td>
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<td>Josephine Musango</td>
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<td>Belinda Bangisi</td>
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<td>Peter Moleele</td>
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<td>Eri Volsteedt</td>
<td>SASOL</td>
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<tr>
<td>Dr.H.L Sharma</td>
<td>INDIA</td>
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<td>Helene Gichenje</td>
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<td>Johannes Kekana</td>
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<tr>
<td>Joseph Kalowekamo</td>
<td>Department of Energy Affairs</td>
<td>Malawi</td>
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</tbody>
</table>
### Acronyms & Explanations

- **ANP** – Agência Nacional do Petróleo
- **BIS** – Bureau of Indian Standards
- **B5** – 5% FAME or B10 – 10% FAME (Standard Automotive Petroleum Diesel)
- **Denatured** – to make ethanol non potable.
- **E10** – this is a petrol blend containing 10% ethanol. E5 is thus a 5% blend
- **EPASA** – Ethanol Producers Association of South Africa
- **FAME** – Fatty Acid Methyl Ester (Biodiesel)
- **Feedstock** – this is the source material that will have differing processes for different feedstock
- **RVP** – Reid Vapour Pressure (ethanol & volatility)
- **IBSA** – India- Brazil- South Africa
- **IS15404** – Indian Biodiesel Standard
- **IS15607** – Indian Bioethanol Standard
- **MS573** – Malawian Standard for Ethanol
- **SABA** – Southern African Bioenergy Association
- **SADC** – Southern African Development Community
- **SANS 342** – South African National Automotive Diesel Specification – blending biodiesel with standard diesel to a max of 5% must not change the standards listed in SANS 342
- **SANS 465** – denatured ethanol used for blending with petrol
- **SANS 1935** – the current standard for bio-diesel produced in South Africa based on European specifications
- **SANS 1598** – specifications which allow for a maximum of 7,5% ethanol at the coast and 9,5% inland in the absence of any other oxygenates
- **UNDP** – United Nations Development Programme

For presentations made at the workshop follow the link below:


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