



# Biodiesel Specifications for South Africa

A black and white photograph of Table Mountain in Cape Town, South Africa. The mountain's flat top is prominent, with a cityscape visible at its base and several trees in the foreground.

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# What is a specification?

Definitions – Oxford dictionary

- **Specification**

A description of something that is sufficiently detailed to provide someone with all the information necessary to manufacture it. See also standard

- **Standard**

Something established for use as rule of basis of comparison in measuring or judging capacity, quantity, content, extent, value, quality, etc.





# Luckily this is not new technology



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# What is Biodiesel??

Fuel made up of mono-alkyl esters of long chain fatty acids from renewable sources

- Vegetable oils
- Used coking oils
- Animal fats
- Tall oil from wood pulp etc



# What is Biodiesel??

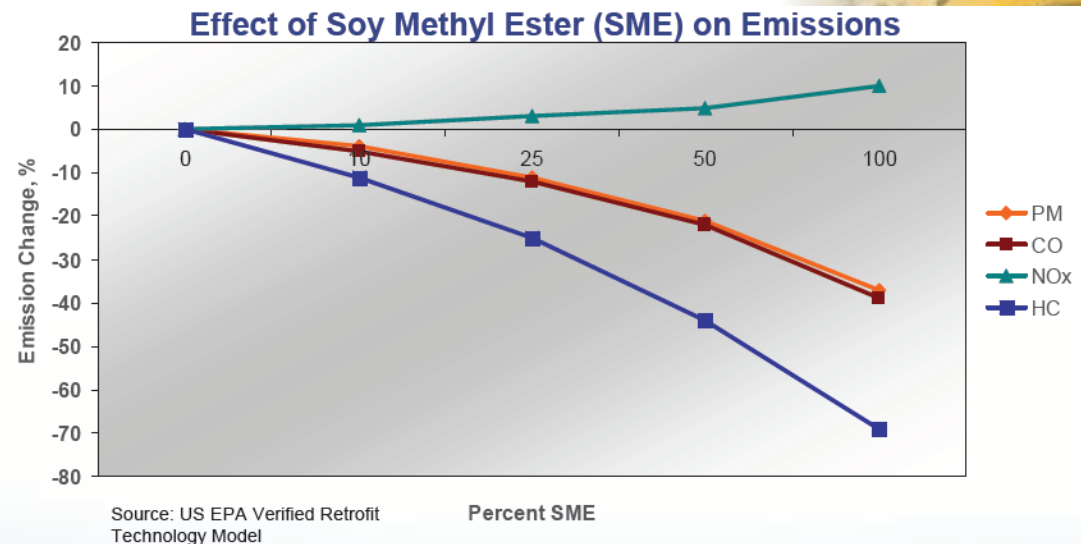
FAME is the common term for Fatty Acid methyl esters

Blended into petroleum diesel at a certain %  
- known as Bx – x% FAME



# Why?

- Lower carbon footprint – if sustainable!
- Alternative that runs with current technology
- Enhances emissions
- Local production
- Job creation



# Biodiesel specifications

- EN14214  
EU standard, based on DIN 51606
- ASTM D6751  
B100 spec for middle distillate
- EMA





# Biodiesel specifications

- Governed by the Petroleum Products Act
  - SANS 1935 – Automotive Biodiesel Fuel
  - SANS 833 [DRAFT] - Biodiesel Production
  - Quality Management System

ICS 75.160.20  
ISBN 0-626-15438-3

**SANS 1935:2004**  
Edition 1

**SOUTH AFRICAN NATIONAL STANDARD**

Automotive biodiesel fuel

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- Based on EN 14214
  - Major difference is Iodine number to accommodate Soy





# Biodiesel specifications

- Used as 100% (neat) in diesel engines
- As a blend in automotive diesel 5% max
- There are no standards for higher blends, although allowed in legislation (with appropriate labelling).

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**SANS 1935:2004**  
Edition 1

**SOUTH AFRICAN NATIONAL STANDARD**

**Automotive biodiesel fuel**

B5  
B10  
B20  
B50  
B100



# Feedstock in South Africa

Mainly

- Used cooking oil
- Fats
- Soy
- Jatropha?



# Requirements

- Manufacturers

- Registered with DoE & SARS
- Meet the minimum quality standard
- Certify product
- Keep records

- Wholesalers

- Registered with DoE & SARS
- Meet the minimum quality standard
- Keep records
- Ensure quality

Relatively onerous requirements?



# Manufacturers

- Many “small” manufacturers, with limited tankage and laboratories.
- High cost to:
  - Batch product
  - Certify
  - Additise
  - Blend
  - Manage a QA program





# Standards & Requirements

- SANS 342 – automotive diesel requires that only certified SANS 1935 (FAME) is blended at max 5%
- Quality Certificates are required

To make it easier – frequency testing is proposed to reduce cost – if there is proven consistency



# Why a specification?



- Damage on Fuel line parts  
metal corrosion, rubber swell  
etc.

- Pump failure sticking  
adhesive material
- Filter plugging  
→ Engine stop  
by stopping fuel supply

- Worsen exhaust gas

- Hard start  
at low temperature

- Deterioration of  
after treatment system

# Why a specification?

## Example of Market Experience (Bio diesel)

### Stick inside FIE



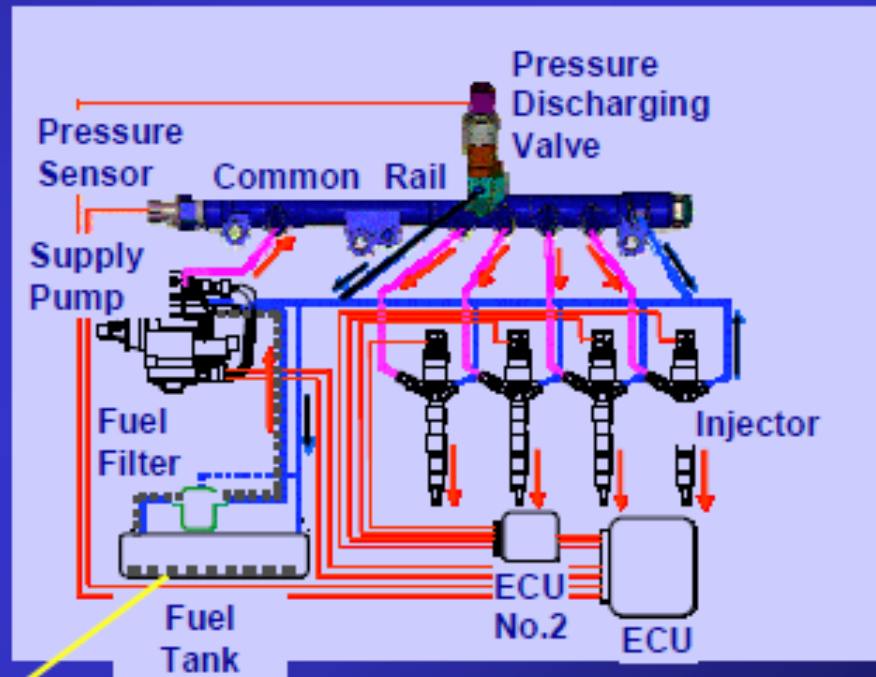
Valve



Filter

Forming Carbonic Acid Salt  
(Adhesive material)

Poor oxidation stability FAME corrodes fuel tank.



# Specifications

	EU:EU	South Africa
Year of implementation	May/09	Jan/05
Spec Name	EN 14214:2008	SANS 1935:2004
Grade	FAME	Automotive biodiesel fuel
<b>Property</b>		
Cetane number, min	51	51
Ester content (concentration), wt%, min	96.5	96.5
Sulfur, ppm, max	10	10
Density @ 15 C (60 F), kg/m3, min	860	860
Density @ 15 C (60 F), kg/m3, max	900	900
Viscosity @ 40 C, cSt, min	3.5	3.5
Viscosity @ 40 C, cSt, max	5	5
Flash Point, C, min	104	120
Carbon residue 10%, wt%, max	0.3	0.3
Water, vol%, max	500	500
Sulfated Ash, wt%, max	0.02	0.02
Total contamination, ppm, max	24	24
Copper corrosion, 3hr @ 100 C, merit (class), max	class 1	class 1
Acid value, mg KOH/g, max	0.5	0.5
Methanol, vol%, max	0.2	0.2
Monoglycerides, wt%, max	0.8	0.8
Diglycerides, wt%, max	0.2	0.2
Triglycerides, wt%, max	0.2	0.2
Glycerol		
Free Glycerol, wt%, max	0.02	0.02
Total, wt%, max	0.25	0.25
Linolenic acid methyl ester, wt%, max	12	12
Polyunsaturated methyl esters, wt%, max	1	1
Iodine number, g/100g, max	120	140
Phosphorus, ppm, max	4	10
Alkali, Group I (Na, K), ppm, max	5	5
Metals, Group II (Ca, Mg), ppm, max	5	5
Cold Filter Plugging Point (CFPP), C, max		-4 (w), +3 (s)(13)
Oxidation stability @ 110 C, hour, min	6	6

26 properties





# Glycerol

- Dependent on the production process
  - high values may stem from insufficient separation or washing of the ester product.
- The glycerol may separate in storage once its solvent methanol has evaporated.
- Free glycerol attracts other polar compounds such as soaps, monoglycerides, etc., and causes damage to the fuel injection system
- Free glycerol corrodes metals in the fuel system
- Free glycerol is also known to clog the fuel filter

Total Glycerol wt %	0.25	EN 14105
Free Glycerol, wt%	0.02	EN 14105



# Ester content

- Low levels may stem from
  - Test methods
  - Feed material
  - Inappropriate reaction conditions
- To determine tax rebates
- Quality

Ester content, wt %

96.5  
EN14103



# Iodine

- an indication of the total unsaturation
- Increased due to feedstock variations
  - Rapeseed oil normally  $\sim 94$  to  $120$
  - Sunflower oil and soybean oil  
 $\sim 118$  to  $140$ .
  - Peanut and cotton seed oils  
 $\sim 86$  and  $123$  units.

Iodine number, g/100g	140	EN14111
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# Iodine

Typically fuels with a high iodine number

- polymerize at high temps and form deposits on
  - Injector nozzles
  - Piston ring grooves
- have low oxidation stability leading to degradation products that lead to poor engine operability

Iodine number, g/100g	140	EN14111
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# Acid number

- Acid number or neutralisation number is a measure of free fatty acids contained in a fresh fuel sample and of free fatty acids and acids from degradation in aged samples. If mineral acids are used in the production process, their presence as acids in the finished fuels is also measured with the acid number.
- Influenced by the type of feedstock used for fuel production & its degree of refinement.
- Acidity can be generated during the production process. The parameter characterises the degree of fuel ageing during storage, as it increases gradually due to degradation of biodiesel.
- Corrosion
- Deposit formation

Acid value, mg KOH/g	0.5 EN 14104
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(Cvengros 1998)



# Sulphated ash

amount of inorganic contaminants such as abrasive solids and catalyst residues, and the concentration of soluble metal soaps contained in the fuel.

- oxidised during combustion to form ash & engine deposits & filter plugging. For these reasons

Sulphated ash, wt%	0.02
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(Mittelbach, 1996)



# Phosphorous

- Increased particulate matter formation
- Poisons exhaust after treatment

Phosphorous, ppm	10
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# Group I & II metals

- Calcium & Magnesium cause pump stick
- Na and K form ash in the engine

Alkali, Group I (Na, K), ppm	5
Group II (Ca, Mg), ppm	5





# Stability

- Oxidation stability is critical property when using neat or blended biodiesel, causing
  - Injector and pump problems
  - Deposit formation

Additives may be  
required

Oxidation stability @ 110 , hour | 6 EN14112



# Other

Cetane number, min	51	ISO 5165
Sulphur, ppm, max	10	ISO 20846, ISO 20884
Density @ 15 C (60 F), kg/m <sup>3</sup> , min	860	ISO 3675, ISO 12185
Density @ 15 C (60 F), kg/m <sup>3</sup> , max	900	
Viscosity @ 40 C, cSt, min	3.5	ISO 3104
Viscosity @ 40 C, cSt, max	5	
Flash Point, C, min	120	ISO 3679
Carbon residue 10%, wt%, max	0.3	ISO 10370
Water, vol%, max	0.05	ISO 12937
Total contamination, ppm, max	24	IP440
Copper corrosion, 3hr @ 100 C, merit (class), max	class 1	ISO 2160
Methanol, vol%, max	0.2	EN 14110
Monoglycerides, wt%, max	0.8	EN 14105
Diglycerides, wt%, max	0.2	EN 14105
Triglycerides, wt%, max	0.2	EN 14105
Linolenic acid methyl ester, wt%, max	12	EN 14103
Polyunsaturated methyl esters, wt%, max	1	-
Phosphorus, ppm, max	10	
Cold Filter Plugging Point (CFPP), C, max	-4 (w), +3 (s)(13)	

# End result

- Only then can it be blended with petroleum diesel and use in Automotive engines.



# Test methods

- Most EN ISO test methods developed for specific feedstocks - Rapeseed
- Variations and changes are required.

These FAME were produced from vegetable oils available in the market at that time, i.e. rapeseed, palm, soy and sunflower oil.





# Sampling Locations

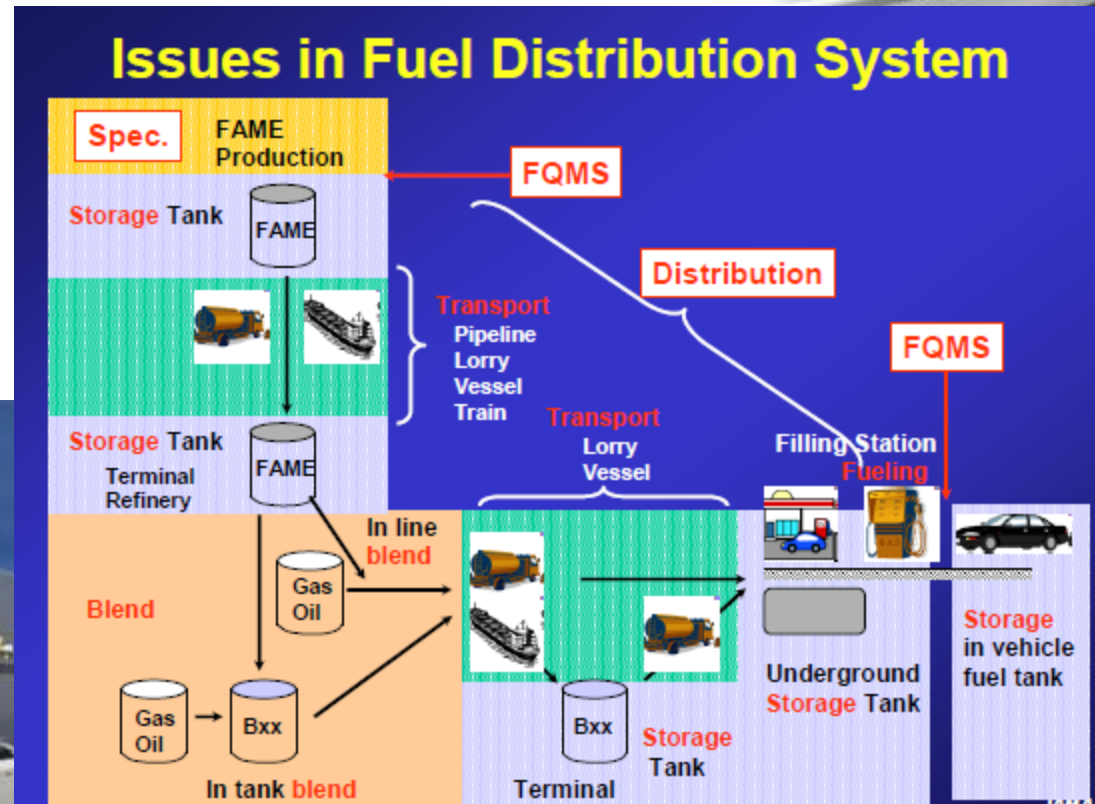
Province	Biodiesel Producers
Gauteng	4
Western Cape	3
Kwa-Zulu Natal	2
Free State	4
Northern Cape	1
Limpopo	1
Eastern Cape	5

# Results

- Two samples complied with SANS 1935
- Eighteen samples did not comply

# Quality

- Need to ensure quality fit for purpose product
  - Feedstock
  - Process
  - QA / QC
  - Handling



# Concluding thoughts

- SA has great specifications to ensure fit for purpose production and distribution
- Aligned to Europe, where our fleet originates
- Work needs to be conducted on differing feedstocks

Specifications must be practical, cost effective, enforceable and implementable





# THANK YOU...



Want to save fuel?  
**Talk to the foot!**

