CRC Report No. E-112

SURVEY OF BIODIESEL CONTENT AT RETAIL DIESEL FUEL OUTLETS IN ILLINOIS AND MINNESOTA

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COORDINATING RESEARCH COUNCIL, INC.

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Survey of Biodiesel Content at Retail Diesel Fuel Outlets in Illinois and Minnesota

CRC Project No. E-112

Final Report

SwRI® Project No. 08-10721

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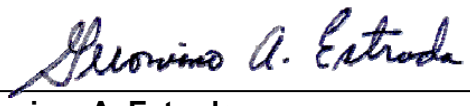

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List of Acronyms

ASTM	ASTM International standards organization formerly known as American Society for Testing and Materials International
BXX	Biodiesel blend containing XX percent biodiesel and the balance diesel
B100	100% Biodiesel
CFR	Code of Federal Regulations
CRC	Coordinating Research Council
EPA	Environmental Protection Agency
FAME	Fatty Acid Methyl Ester
FTC	Federal Trade Commission
NBB	National Biodiesel Board
ppm	Parts per million
SwRI®	Southwest Research Institute
ULSD	Ultra Low Sulfur Diesel
vol%	Volume percent
W&S	Water and Sediment

Executive Summary

Various states have either adopted or are considering actions to encourage or require higher levels of biodiesel in diesel fuel. Minnesota, starting in July of 2014, requires all diesel fuel sold in the state and intended for use in non-exempt compression ignition engines to contain a minimum of 10% biodiesel by volume during the months of April through September. In 2003 Illinois established tax incentives to encourage the use of diesel fuel blended with biodiesel at per gallon concentrations greater than 10% and less than 99% by volume.

In order to understand the diversity of the fuel pool created by these two state legislative actions, the Coordinating Research Council (CRC) sponsored a survey by Southwest Research Institute® (SwRI) of market diesel fuel quality at retail outlets in Illinois and Minnesota. SwRI selected the retail outlets from a list of target areas provided by CRC and obtained four fuel samples in Minnesota and twelve samples in Illinois.

SwRI analyzed all of the samples for biodiesel content, oxidative stability, and various other properties listed in the ASTM D7467 *"Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)"*. The measured properties of the samples were within the specification with the exception of the sample from one station. The oxidative stability for that one sample was well below the 6 hour limit established in ASTM D7467. The same station also had a biodiesel content less than the minimum volume percent established for the tax credit in Illinois

Photographs of the service stations revealed that the majority are in compliance with product labeling regulatory requirements. Fourteen of the sixteen station's dispensers had the ultra low sulfur diesel (ULSD) required by the EPA and thirteen of the dispensers had the blue BXX biodiesel labels required by the FTC. Two of the stations had an additional label stating that the diesel fuel dispensed from the pump was not a branded product.

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Introduction

Minnesota and Illinois are encouraging the use of biodiesel through mandates and tax incentives. Minnesota Statute Chapter 239 Section 239.77 "Biodiesel Mandate" requires the level of biodiesel in all diesel fuel sold in the state and intended for use in non-exempt compression ignition engines during the months of April through September to contain a minimum of 10 vol% biodiesel starting May 1, 2012. Implementation was delayed until July 1, 2014 due to inadequate blending infrastructure. Illinois encouraged the use of biodiesel through a tax incentive as described in Illinois Statute Chapter 35 Section 105/3-10. Diesel fuel having a biodiesel content greater than 10 vol% and less than or equal to 99 vol% is exempt from the "Use Tax". This has the effect of creating a fuel pool that could have biodiesel content ranging from greater than 10.5 vol% to less than 99.5 vol%.

In order to understand the diversity of the fuel pool created by the legislative actions of these two states, the Coordinating Research Council (CRC) sponsored a market survey of selected diesel fuel qualities at retail outlet in Minnesota and Illinois. Four service stations were sampled in Minnesota and 12 in Illinois, and the fuels obtained were measured for various properties specified in the ASTM D7467 standard specification.

Methodology

Station Identification

Service stations were initially selected based upon information obtained from the National Biodiesel Board's (NBB) retail location map at www.biodiesel.org for twelve of the sixteen areas targeted by CRC. An attempt was made to contact each station to confirm that they marketed diesel fuel containing biodiesel meeting the sampling criteria. Four of these twelve stations were found to be card lock stations, one station had a disconnected phone line, and there was no answer at one other station. At two additional stations, the attendant could not confirm the biodiesel blend level, resulting in only four stations that met the sampling criteria. The next source consulted was the U.S. Department of Energy's Alternative Fuels Data Center which had limited information on the availability of biodiesel in the target areas. Only one station was identified from this source and had already been identified from the NBB website.

The remaining twelve stations were identified using a combination of www.GasBuddy.com and Google Maps. The target location was entered into the www.GasBuddy.com search engine filtered on stations carrying diesel. The Google Maps website was then used to confirm that the service stations were actually in the prescribed target area. Once a station was identified, a phone call was placed to the store to confirm that it marketed diesel fuel containing biodiesel meeting the sampling criteria.

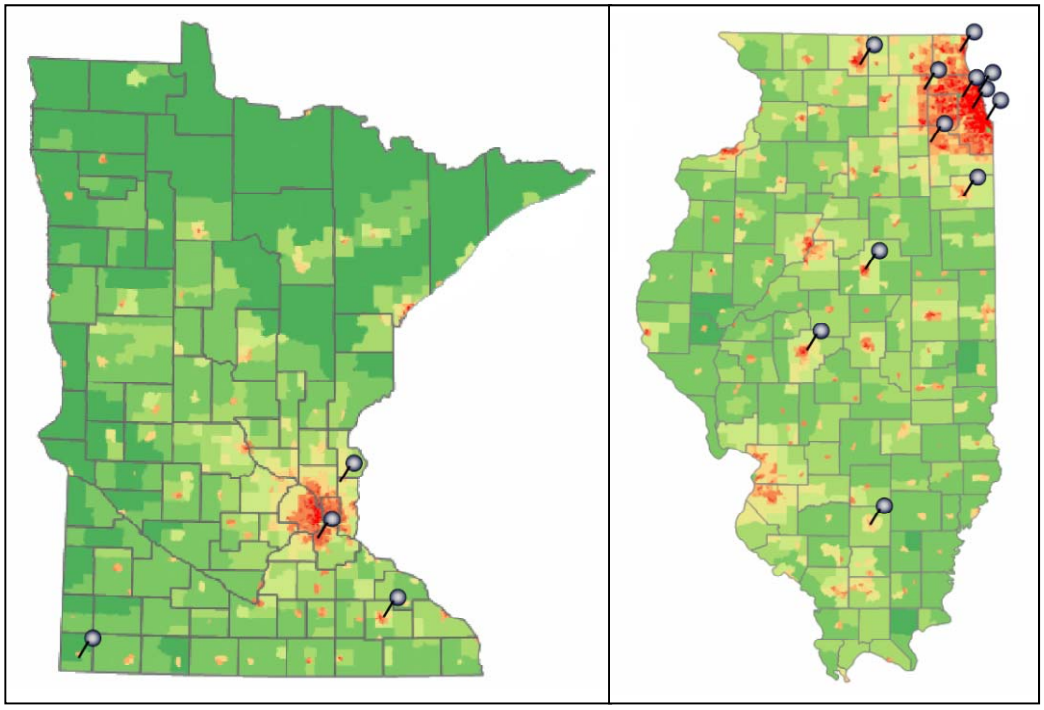

Figure 1. Retail station Locations

Sample Collection and Photographs

An independent contractor was scheduled to collect a fuel sample from each of the 16 selected retail stations. A box containing four 2.5 liter seamless aluminum containers was shipped to the sampling contractor. The contractor dispensed two liters of product into one of the empty 2.5 L container labeled as "flush". A second 2.5 L container was filled with two liters of the sample to be tested. Two of the containers remained empty and served to maintain the structural integrity of the box used for shipping the samples. All samples were collected between September 12th and 14th of 2014, coinciding with the summer diesel fuel season and the April 1st to September 30th Minnesota B10 blend season.

While at the station the contractor was instructed to take the following four photographs:

- A close up photograph of the pump encompassing the area of the product selection buttons, the volume display and any labeling and product identification information
- A view of the entire pump including the hoses
- A photograph of the entire island in which the biodiesel pump is located
- A photograph showing the island containing the biodiesel pump in relation to the other islands at the retail station

Both the flushed sample and the test sample were packaged and shipped back to SwRI® in accordance with 49 CFR Chapter 1 Department of Transportation Pipeline and Hazardous

Materials Safety Administration regulations. When the samples arrived at SwRI®, they were each assigned a unique lab sequence identification in addition to the unique process ID number.

Property Analysis

The Biodiesel content of the samples was analyzed by method EN14078 "*Determination of fatty acid methyl ester (FAME) content in middle distillates – Infrared spectrometry method"*. The results were then compared to the respective state blending requirements. The oxidation stability was determined in accordance with method EN15751 "*Determination of oxidation stability by accelerated oxidation method"* also known as the Rancimat test. The distillation profiles of the blends were measured by method ASTM D86 *"Distillation of Petroleum Products at Atmospheric Pressure"*. The Oxidation stability and the 90% recovered values were compared against the specification limits cited in ASTM D7467 "*Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)"*.

In addition, other fuel properties were measured using the following test methods from ASTM D7467:

- ASTM D2709 *Water and Sediment in Middle Distillate Fuels by Centrifuge*
- ASTM D5453 *Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence*
- ASTM D6304 *Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration*
- ASTM D664 *Acid Number of Petroleum Products by Potentiometric Titration*

Results

Biodiesel content

With the exception of one sample, all the results met the minimum requirements of the mandate or tax incentive. Two of the four Minnesota samples measured 9.9 vol% biodiesel which is technically below the minimum level. However, since the limit in the Minnesota statute is given to the whole number, these two values would round to 10 vol% bringing the samples into compliance. One of the Illinois samples had a measured value of 9.8 vol%. The Illinois tax exemption is also stated in terms of the whole volume percent. However, since the exemption requires greater than 10 vol%, rounding the measured result to 10 vol% would disqualify this sample for the tax exemption. The difference in the way that the 10 vol% minimum levels are defined in Illinois (>10 vol%) and Minnesota (>=10vol%) effectively increases the minimum biodiesel content to 10.6 vol% in Illinois while maintaining a 10 vol% minimum content in Minnesota. This is clearly evident in Figure 2, where the Minnesota samples vary about the 10 vol% line while the Illinois samples are generally greater than 10.5 vol%.

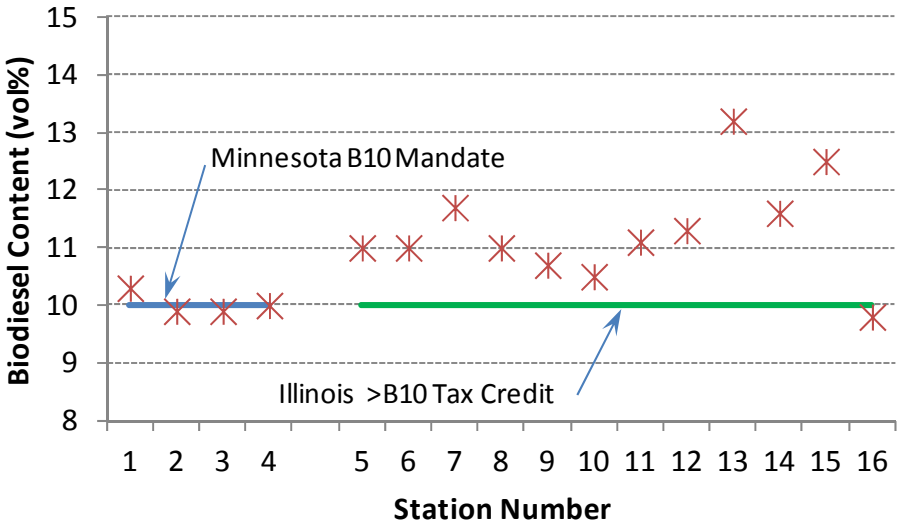

Figure 2. Biodiesel content

Oxidation Stability

Eleven of the sixteen samples had oxidation stability greater than 24 hours without an evident induction period as determined by EN15751. Four of the remaining five samples did exhibit an induction period less than 24 hours and were all above the minimum 6 hour limit as specified by ASTM D7467. The oxidation stability for the sample from Station 16 was 3.7 hours, which is below the 6 hour oxidation stability requirement of D7467.

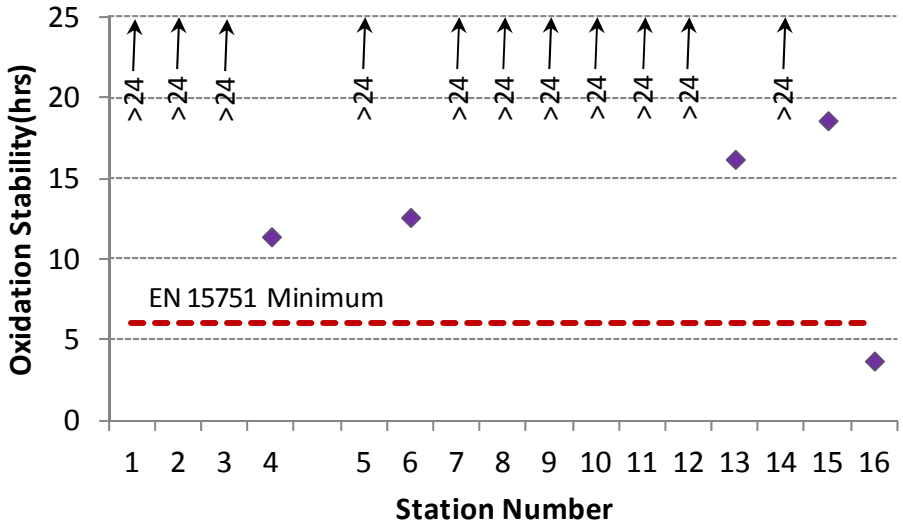

Figure 3. Oxidation stability

Distillation

All the analyzed samples easily met the maximum limit for the 90% recovered as measured by ASTM D86. All of the samples also were well below the #2 diesel 90% recovered limit of 338 C, indicating that fuels containing 10 vol% biodiesel were not adversely affected by this requirement. Even Station 16, which failed the oxidation stability requirement and did not meet the tax exempt volume limit, met the 90% recovered requirement.

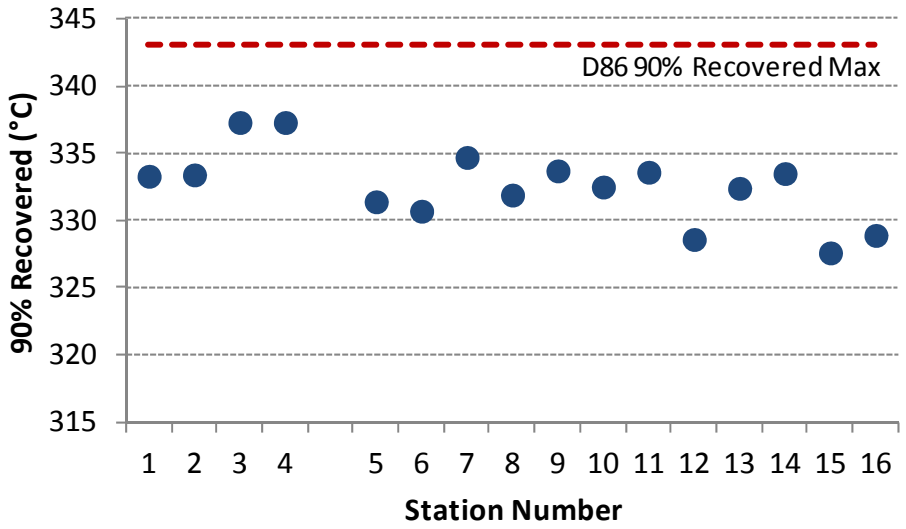

Figure 4. Distillation 90% recovered

Other fuel property results

All other measured fuel properties met the ASTM D7467 specification. Table 1 shows the summary statistics grouped by state. For example, all of the water and sediment values were less than 0.005 vol%. The sulfur levels were all less than 15 ppm. The acid numbers were well below the 0.3 mg KOH/g specification limit.

Table 1. Summary of results

Method	Property	Units	D7467 Specification Limit	Minnesota # of Samples	Minnesota Arithmetic Mean	Minnesota Median	Minnesota Standard Deviation	Illinois # of Samples	Illinois Arithmetic Mean	Illinois Median	Illinois Standard Deviation
EN14078	FAME	vol%	6.-20.	4	10.03	9.95	0.19	12	11.28	11.05	0.9
EN15751	Average	hours	6 min	1	11.4	11.4	---	4	12.78	14.4	6.53
				3	>24	---	---	8	>24	---	---
D5453	Sulfur	ppm	15 max	4	5.68	5.9	2.11	12	7.27	7.85	1.37
D6304	Water	mg/kg		4	67	67.5	17	12	95	96	28
D664	Inflection	mg KOH/g	0.3 max	4	0.07	0.065	0.01	12	0.08	0.08	0.01
D2709	W&S	Vol%	0.05 max	4	< 0.005	---	---	12	< 0.005	---	---
D86	IBP	°C		4	175.30	174.05	2.95	12	173.23	174.75	4.26
	5% Recovered	°C		4	200.28	200.0	2.80	12	207.39	206.75	2.39
	10% Recovered	°C		4	211.23	212.25	2.96	12	219.05	218.65	1.71
	15% Recovered	°C		4	220.15	221.05	2.77	12	228.15	227.35	2.01
	20% Recovered	°C		4	228.30	229.0	2.73	12	235.02	234.3	1.62
	30% Recovered	°C		4	242.98	243.3	2.55	12	248.13	247.9	1.70
	40% Recovered	°C		4	257.80	257.5	1.72	12	261.06	260.45	1.91
	50% Recovered	°C		4	272.78	272.75	1.31	12	274.64	274.05	1.87
	60% Recovered	°C		4	288.38	288.85	1.57	12	288.82	288.7	1.96
	70% Recovered	°C		4	304.00	304.15	1.74	12	303.33	303.45	1.93
	80% Recovered	°C		4	319.13	319.35	1.94	12	317.28	317.55	2.03
	90% Recovered	°C	343	4	335.33	335.35	2.28	12	331.63	332.15	2.26
	95% Recovered	°C		4	350.65	351.15	3.82	12	344.04	343.7	4.01
	FBP	°C		4	358.28	358.2	4.49	12	350.64	351.5	2.52
	Recovered	mL		4	97.88	97.95	0.42	12	97.78	97.8	0.6
	Residue	mL		4	1.23	1.2	0.15	12	1.17	1.2	0.2
	Loss	mL		4	0.9	0.8	0.38	12	1.15	1.2	0.58

Pump Labeling and Station Configuration

While acquiring the samples for testing, the contractors also took note of the biodiesel and sulfur content labels posted on the particular pump they were sampling. Fourteen of the sixteen service stations displayed the ultra low sulfur diesel fuel label required by the EPA and codified in 40 CFR § 80.570(a). The required label has a specified font size and must be printed in bold type and in contrasting colors. The label informs the consumer that the fuel contains a maximum sulfur level of 15 ppm. The label also states that the fuel is ***required*** for use in all highway vehicles and engines and is recommended for use in all vehicles and engines. Figure 5 is typical of this type of label. It was interesting to note that Station 16 positioned the ULSD above the gasoline nozzle. Two stations did not display any sulfur labels on the pump.

The EPA regulation mandating the labeling of pumps dispensing ULSD had an end date of November 30th, 2014. While non-compliant at the time of the sampling, the two stations identified as not having the ULSD labels were in compliance at the time of this report.

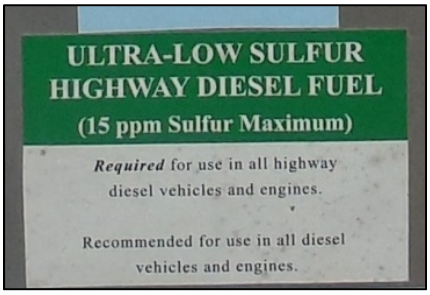

Figure 5. Ultra low sulfur diesel label

Twelve of the sixteen stations displayed the blue "Biodiesel Blend" label containing the phrase "contains biomass-based diesel or biodiesel in quantities between 5 percent and 20 percent" as required by Federal Trade Commission regulations 16 CFR § 306.12 (4). Figure 6 is typical of the biodiesel blend label used. One station displayed a "B11" biodiesel blend label. One station had an alternative label, and two stations had no biodiesel blend labels.

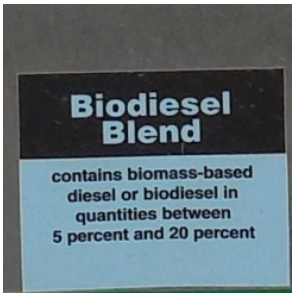

Figure 6. Biodiesel blend label

Even though Station 12 had the standard blue biodiesel blend label, there was an additional label affixed to the pump above the biodiesel blend label. This label indicated that the fuel being dispensed from that pump was not a branded product. Figure 7 is a photograph of this label.

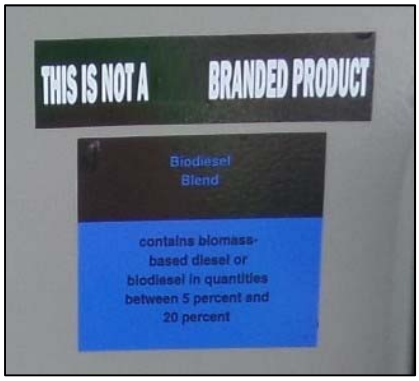

Figure 7. Brand disclaimer

By far the most interesting label was the alternative label seen at Station 5. This label appeared to warn the consumer that the fuel might not meet the vehicle warranty requirements and

additionally differentiated the product from the branded fuels offered at the same station. The label does indicate that the fuel dispensed from the pump contains more than 5% biodiesel, but it does not indicate an upper limit. It also suggests that the user should consult their owner's manual to confirm that B6 to B20 is a suitable fuel for their vehicle. Figure 8 shows the actual disclaimer directly beneath the diesel nozzle.

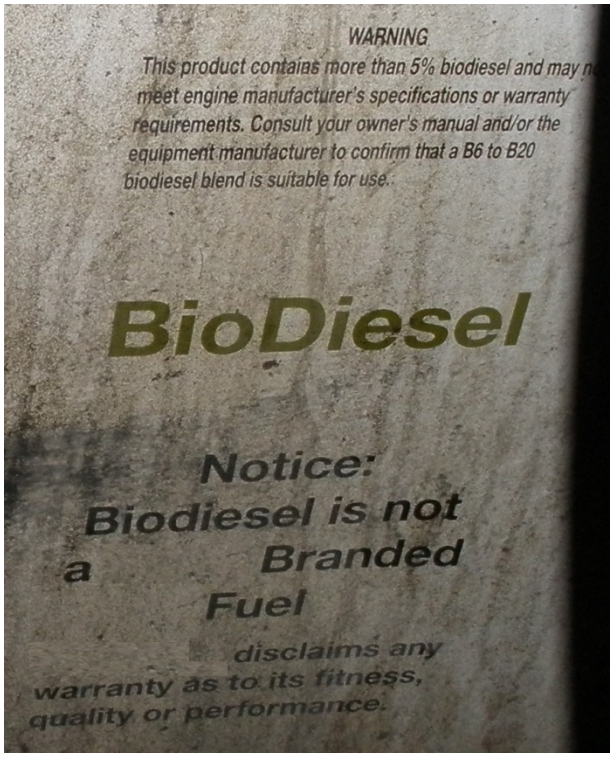

Figure 8. Brand disclaimer and warning

The majority of the stations had the biodiesel blend pump under the canopy with the rest of the branded products; only Station 4 had the diesel pumps segregated from the rest of the pumps at the station. Including Stations 5 and 12 discussed above, three out of sixteen of the retail outlets surveyed (almost 19%) did not market the B6 to B20 biodiesel blend as a branded product.

Table 2. Pump Labeling Summary

Station	Sulfur Label	Biodiesel Label	Station	Sulfur Label	Biodiesel Label
1	15ppm-All	B5 to B20%	9	15ppm-All	B5 to B20%
2	15ppm-All	B5 to B20%	10	None	None
3	15ppm-All	B5 to B20%	11	15ppm-All	B5 to B20%
4	15ppm-All	B5 to B20%††	12	15ppm-All	B5 to B20%†
5	15ppm-All	None*†	13	15ppm-All	B5 to B20%
6	15ppm-All	B5 to B20%	14	15ppm-All	B11
7	15ppm-All	None	15	None	B5 to B20%
8	15ppm-All	None	16	15ppm-All	B5 to B20%

* - Biodiesel content was posted in an alternate label

† - Disclaimer indicating the fuel was not a branded product

†† - Dispenser was not under the canopy

None – Indicates that a regulated label was not readily apparent on the pump.

15 ppm –All – The ULSD label indicating the fuel is required for all highway vehicles and recommended for use in all vehicles and engines

B5 to B20% - The blue biodiesel blend label indicating a range of content.

B11 – The blue biodiesel blend label indicating a specific biodiesel volume.

Conclusions

A small survey of biodiesel fuel provides data on how the legislative action in the states of Minnesota and Illinois may be having an impact on the fuel pool in these two states. Minnesota samples were observed to contain biodiesel at or near the minimum level required in that state. Illinois samples typically contained more biodiesel than the minimum level specified. Overall, the analyzed fuel properties of the diesel fuels tested in this survey were consistent with the requirements of ASTM specification for biodiesel blends (B6 to B20). Only one property of one sample exceeded the specification limits.

Appendix A: Station Photographs

Note: products tested in this study are not associated with any brands shown in the photos

Station #1

Lab ID: MISC 58321
Location: Burnsville
State: Minnesota
Zip: 55337
Date Sampled: 9/12/14
Dispenser Number: 1
Comments:

Fueling Positions: 6
Number of Diesel Pumps: 6
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.1.1. Station 1 close up

Figure A.1.2. Station 1 pump

Figure A.1.3. Station 1 island

Figure A.1.4. Station 1 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #2

Lab ID: MISC 58320
Location: Forest Lake
State: Minnesota
Zip: 55025
Date Sampled: 9/12/14
Dispenser Number: 13
Comments:

Fueling Positions: 19
Number of Diesel Pumps: 7
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.2.1. Station 2 close up

Figure A.2.2. Station 2 pump

Figure A.2.3. Station 2 island

Figure A.2.4. Station 2 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #3

Lab ID: MISC 58322
Location: Rochester
State: Minnesota
Zip: 55904
Date Sampled: 9/12/14
Dispenser Number: 11
Comments:

Fueling Positions: 16
Number of Diesel Pumps: 6
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.3.1. Station 3 close up

Figure A.3.2. Station 3 pump

Figure A.3.3. Station 3 island

Figure A.3.4 Station 3 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #4

Lab ID: MISC 58318
Location: Luverne
State: Minnesota
Zip: 56156
Date Sampled: 9/14/14
Dispenser Number: 9
Comments:

Fueling Positions: 16
Number of Diesel Pumps: 8
Posted Sulfur: 15ppm -All
Pump Under Canopy: No
Posted Biodiesel: B5:B20

Station Photos

Figure A.4.1. Station 4 close up

Figure A.4.2. Station 4 pump

Figure A.4.3. Station 4 island

Figure A.4.4 Station 4 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #5

Lab ID: MISC 58316
Location: Cicero
State: Illinois
Zip: 60804
Date Sampled: 9/14/14
Dispenser Number: 5
Comments:

Fueling Positions: 14
Number of Diesel Pumps: 2
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: Atypical Label

Station Photos

Figure A.5.1. Station 5 close up

Figure A.5.2. Station 5 pump

Figure A.5.3. Station 5 island

Figure A.5.4 Station 5 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #6

Lab ID: MISC 58312
Location: Chicago: Lincoln Park
State: Illinois
Zip: 60613
Date Sampled: 9/13/14
Dispenser Number: 4
Comments:

Fueling Positions: 14
Number of Diesel Pumps: 4
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.6.1. Station 6 close up

Figure A.6.2. Station 6 pump

Figure A.6.3. Station 6 island

Note: products tested in this study are not associated with any brands shown in the photos

Station #7

Lab ID: MISC 58315
Location: South Chicago
State: Illinois
Zip: 60619
Date Sampled: 9/13/14
Dispenser Number: 8
Comments:

Fueling Positions: 8
Number of Diesel Pumps: 2
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: No Biodiesel Label

Station Photos

Figure A.7.1. Station 7 close up

Figure A.7.2. Station 7 pump

Figure A.7.3. Station 7 island

Figure A.7.4. Station 7 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #8

Lab ID: MISC 58311
Location: Schiller Park
State: Illinois
Zip: 60176
Date Sampled: 9/13/14
Dispenser Number: 7
Comments:

Fueling Positions: 8
Number of Diesel Pumps: 2
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: No Biodiesel Label

Station Photos

Figure A.8.1. Station 8 close up

Figure A.8.2. Station 8 pump

Figure A.8.3. Station 8 island

Note: products tested in this study are not associated with any brands shown in the photos

Station #9

Lab ID: MISC 58314
Location: Gurnee
State: Illinois
Zip: 60031
Date Sampled: 9/14/14
Dispenser Number: 24
Comments:

Fueling Positions: 30
Number of Diesel Pumps: 8
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.9.1. Station 9 close up

Note: products tested in this study are not associated with any brands shown in the photos

Station #10

Lab ID: MISC 58313
Location: Elgin
State: Illinois
Zip: 60123
Date Sampled: 9/13/14
Dispenser Number: 6
Comments:

Fueling Positions: 6
Number of Diesel Pumps: 2
Posted Sulfur: No Sulfur PPM Label
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.10.1 Station 10 close up

Figure A.10.2. Station 10 pump

Figure A.10.3. Station 10 island

Note: products tested in this study are not associated with any brands shown in the photos

Station #11

Lab ID: MISC 58324
Location: Joliet
State: Illinois
Zip: 60435
Date Sampled: 9/14/14
Dispenser Number: 8
Comments:

Fueling Positions: 12
Number of Diesel Pumps: 4
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.11.1. Station 11 close up

Figure A.11.2. Station 11 pump

Figure A.11.3. Station 11 island

Figure A.11.4 Station 11 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #12

Lab ID: MISC 58310
Location: Rockford
State: Illinois
Zip: 61109
Date Sampled: 9/13/14
Dispenser Number: 11
Comments:

Fueling Positions: 12
Number of Diesel Pumps: 2
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.12.1. Station 12 close up

Figure A.12.2. Station 12 pump

Figure A.12.3. Station 12 island

Figure A.12.4. Station 12 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #13

Lab ID: MISC 58323
Location: Kankakee
State: Illinois
Zip: 60901
Date Sampled: 9/13/14
Dispenser Number: 2
Comments:

Fueling Positions: 24
Number of Diesel Pumps: 16
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.13.1. Station 13 close up

Figure A.13.2. Station 13 pump

Figure A.13.3. Station 13 island

Figure A.13.4. Station 13 configuration

Station #14

Lab ID: MISC 58317

Location: Bloomington

State: Illinois

Zip: 61701

Date Sampled: 9/14/14

Dispenser Number: 1

Comments:

Fueling Positions: 8

Number of Diesel Pumps: 8

Posted Sulfur: 15ppm -All

Pump Under Canopy: Yes

Posted Biodiesel: B11

Station Photos

The manager came out to the pump while the fuel sample was being procured. The manager informed the contractor that he was not allowed to take any pictures of the pump, the store or anywhere on site. He said that the company has a no photos allowed policy.

Note: products tested in this study are not associated with any brands shown in the photos

Station #15

Lab ID: MISC 58309
Location: Springfield
State: Illinois
Zip: 62702
Date Sampled: 9/14/14
Dispenser Number: 5
Comments:

Fueling Positions: 8
Number of Diesel Pumps: 2
Posted Sulfur: No Sulfur PPM Label
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.15.1. Station 15 close up

Figure A.15.2. Station 15 pump

Figure A.15.3. Station 15 island

Figure A.15.4. Station 15 configuration

Note: products tested in this study are not associated with any brands shown in the photos

Station #16

Lab ID: MISC 58319
Location: Mt Vernon
State: Illinois
Zip: 62864
Date Sampled: 9/12/14
Dispenser Number: 3
Comments:

Fueling Positions: 12
Number of Diesel Pumps: 8
Posted Sulfur: 15ppm -All
Pump Under Canopy: Yes
Posted Biodiesel: B5:B20

Station Photos

Figure A.16.1. Station 16 close up

Figure A.16.2. Station 16 pump

Figure A.16.3. Station 16 island

Figure A.16.4 Station 16 configuration

Appendix B: Tabulated Fuel Property Data

Table B.1 Fuel Property Data

Station Number	FAME EN14078 volume %	Oxidation Stability EN15751 hours	Sulfur D5453 ppm	Water D6304 mg/kg	Acidity D664 mg KOH/g	W&S D2709 vol%
Minnesota						
1	10.3	>24hr	8.0	71	0.06	< 0.005
2	9.9	>24hr	6.2	47	0.06	< 0.005
3	9.9	>24hr	2.9	64	0.07	< 0.005
4	10.0	11.4	5.6	87	0.09	< 0.005
Mean	10.03		5.68	67	0.07	
Median	9.95		5.9	67.5	0.065	
Std. Dev	0.19		2.11	17	0.01	
Illinois						
5	11.0	>24hr	8.8	99	0.09	< 0.005
6	11.0	12.6	8.0	131	0.07	< 0.005
7	11.7	>24hr	8.0	68	0.09	< 0.005
8	11.0	>24hr	7.5	55	0.06	< 0.005
9	10.7	>24hr	7.7	134	0.07	< 0.005
10	10.5	>24hr	8.1	130	0.07	< 0.005
11	11.1	>24hr	7.2	88	0.08	< 0.005
12	11.3	>24hr	8.2	104	0.07	< 0.005
13	13.2	16.2	5.6	93	0.09	< 0.005
14	11.6	>24hr	8.3	52	0.08	< 0.005
15	12.5	18.6	5.4	106	0.09	< 0.005
16	9.8	3.7	4.4	84	0.08	< 0.005
Mean	11.28		7.27	95	0.08	
Median	11.05		7.85	96	0.08	
Std Dev	0.90		1.37	28	0.01	

Station Number	IBP D86 °C	5% Recovered D86 °C	10% Recovered D86 °C	15% Recovered D86 °C	20% Recovered D86 °C	30% Recovered D86 °C
Minnesota						
1	173.9	200.6	211.9	221.8	230.6	245.6
2	173.4	199.4	212.6	220.3	227.9	242.4
3	179.7	203.9	213.5	222.3	230.1	244.2
4	174.2	197.2	206.9	216.2	224.6	239.7
Mean	175.30	200.28	211.23	220.15	228.3	242.98
Median	174.05	200	212.25	221.05	229	243.3
Std. Dev	2.95	2.80	2.96	2.77	2.73	2.55
Illinois						
5	175.2	204.0	216.5	225.9	233.2	246.6
6	176.4	206.8	218.8	227.5	234.2	247.4
7	174.3	206.7	218.5	227.2	234.7	247.3
8	165.3	204.5	217.2	226.8	234.2	248.1
9	170.1	205.2	217.7	227.2	234.1	248.1
10	175.8	206.4	218.4	226.2	233.5	245.9
11	167.4	209.4	220.1	231.2	237.6	250.2
12	169.3	211.6	220.6	231.4	236	247.9
13	177.4	210.7	222.8	231.2	238.1	251.9
14	172.5	208.5	219.8	228.7	236.4	249.7
15	177.0	208.5	220.0	227.6	233.8	246.6
16	178.1	206.4	218.2	226.9	234.4	247.9
Mean	173.23	207.39	219.05	228.15	235.02	248.13
Median	174.75	206.75	218.65	227.35	234.3	247.9
Std Dev	4.26	2.39	1.71	2.01	1.62	1.7

Station Number	40% Recovered D86 °C	50% Recovered D86 °C	60% Recovered D86 °C	70% Recovered D86 °C	80% Recovered D86 °C	90% Recovered D86 °C
Minnesota						
1	260.0	274.4	288.9	303.6	318.1	333.3
2	256.7	271.2	286.1	301.8	316.9	333.4
3	258.3	272.8	288.8	304.7	320.6	337.3
4	256.2	272.7	289.7	305.9	320.9	337.3
Mean	257.80	272.78	288.38	304.00	319.13	335.33
Median	257.5	272.75	288.85	304.15	319.35	335.35
Std. Dev	1.72	1.31	1.57	1.74	1.94	2.28
Illinois						
5	259.7	273.8	288.1	302.8	317.0	331.4
6	260.0	273.4	287.6	302.1	316.4	330.7
7	260.7	274.2	289.3	304.8	319.2	334.7
8	260.7	274.9	289.4	303.8	317.5	331.9
9	261.4	275.4	290.2	305.0	319.4	333.7
10	258.8	272.9	287.8	303.1	317.6	332.5
11	263.3	276.8	290.6	304.8	318.7	333.6
12	260.2	273.1	286.8	301.4	314.8	328.6
13	265.3	278.7	292.7	306.3	319.4	332.4
14	263.1	276.3	290.5	304.9	319.1	333.5
15	259.3	272.3	286.2	300.2	313.9	327.6
16	260.2	273.9	286.6	300.7	314.3	328.9
Mean	261.06	274.64	288.82	303.33	317.28	331.63
Median	260.45	274.05	288.7	303.45	317.55	332.15
Std Dev	1.91	1.87	1.96	1.93	2.03	2.26

Station Number	95% Recovered D86 °C	FBP D86 °C	Recovered D86 °C	Residue D86 mL	Loss D86 mL
Minnesota					
1	346.0	355.8	98.0	1.4	0.6
2	349.1	353.4	97.3	1.3	1.4
3	354.3	363.3	98.3	1.1	0.6
4	353.2	360.6	97.9	1.1	1.0
Mean	350.65	358.28	97.88	1.23	0.90
Median	351.15	358.2	97.95	1.2	0.8
Std. Dev	3.82	4.49	0.42	0.15	0.38
Illinois					
5	343.4	352.1	98.2	0.0	1.8
6	341.9	352.0	98.2	1.2	0.6
7	349.4	351.6	96.7	1.2	2.1
8	344.0	352.1	97.8	1.2	1.0
9	348.1	353.0	97.3	1.3	1.4
10	345.7	353.6	97.8	1.3	0.9
11	348.4	351.4	97.4	1.2	1.4
12	337.9	349.2	99.0	0.7	0.3
13	342.2	350.4	98.3	1.4	0.3
14	348.0	350.6	97.3	1.2	1.5
15	337.4	345.6	97.8	1.3	0.9
16	342.1	346.1	97.5	0.9	1.6
Mean	344.04	350.64	97.78	1.17	1.15
Median	343.7	351.5	97.8	1.2	1.2
Std Dev	4.01	2.52	0.60	0.20	0.58