IASH

Newsletter No. 42
June 2010

International Association For
Stability Handling & Use of Liquid Fuels

SUSTAINING MEMBERS:
Air BP
ConocoPhillips
ExxonMobil Aviation
Fuel Quality Services, Inc.
Parker Hannifin
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Shell Aviation
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US Defense Energy Support Center
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Chevron Global Aviation
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GE Aviation
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International Association For
Stability
Handling
& Use of
Liquid Fuels

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June 2010

Melanie Thom – Newsletter Editor (MelanieAThom@cs.com)

The International Association for Stability, Handling and Use of Liquid Fuels, IASH, was founded in 1986. The purposes of the Association are to promote research and experimentation on the scientific and operational factors that affect the stability and handling of liquid fuels during their manufacture, blending, transportation, storage and use; and to provide a forum for the exchange of related ideas and information. Liquid fuels include crude oil and its refined products; products derived or processed from oil shale, tar sands, coal and natural gas; and reformulated fuels such as those containing oxygenated components.

To accomplish its purposes and to promote a better understanding of the problems associated with the stability and handling of liquid fuels, IASH publishes a biannual newsletter, sponsors international conferences and publishes their proceedings. The Newsletter provides members with a medium for publishing notes on research in progress, discussing a problem that has been encountered with the stability and/or handling of a fuel, or commenting on some related technical issue of a general interest. IASH is an international, non-governmental, interdisciplinary, volunteer association. Membership is open to all individuals and organizations subscribing to its purposes.

Further information pertaining to IASH, including membership and availability of past conference proceedings, is available from the secretariat:

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A Note from the Chairman
By Robert E. Morris, US Naval Research Laboratory

I would like to begin by thanking Graham Hill for his years of service to IASH. He began his service six years ago when he became 2nd Vice Chairman from 2004 through 2005. He then served as 1st Vice Chairman from 2006 through 2007, and finally as Chairman from 2008 through 2009. For someone who was running a small consulting company, it was remarkable that he was able to spend the time and effort on IASH that he did through those years. He was also responsible for choosing Prague for the 2009 Conference, which was thoroughly enjoyed by all who attended.

The IASH Board of Directors held its annual meeting in early May. It was reported that we currently have 215 members in IASH. Our membership has remained steady for several years. The Board discussed ways to increase our membership and to increase awareness of IASH. It was agreed to produce a 1-page information brochure about the Association and board members would bring them to conferences to distribute. We will all benefit from a greater awareness of IASH and I would also like to encourage all members to tell your colleagues about IASH. We can also make our PR brochure available to any members who wish to distribute them at any relevant event or location. It was also decided by the Board to distribute informational brochures by mail (not e-mail). Thus, we are currently assembling an appropriate mailing list. Any suggestions will be welcome. You can find the vision and mission of IASH on the website at www.iash.net. For your reference, following is the vision of IASH:

To be the foremost international organization devoted to all aspects of the stability, handling, and use of liquid fuels from refinery to end us and disposal, utilizing volunteers to maintain the autonomy from single organizations or companies.

Currently, there are 25 Board members plus two Supporting Members who share one vote on the Board. Ten companies have committed to Sustaining Membership in IASH for 2010 for total funding in the amount of $50,000. Seven companies have committed to Supporting Membership for 2010 for total funding in the amount of $14,200. They provide the majority of income to the association that allows it to function as an independent organization. Those companies are listed on the cover page of the *Newsletter*.

IASH ended 2009 with a minimal loss of $7,407. As you are aware, this was due to several events beyond our control that led to the loss from the 2009 Conference held in Prague. However, we were able to sustain the loss and reduce it substantially with other income. Our budget for 2010 provides for income of $73,200 and expenses of $40,980 with net income of $32,220. The IASH bank account had over $150,000 at the end of the First Quarter 2010. Therefore, I am happy to report that the association is in good financial condition!

Mark your calendars to attend the 12th International Conference on Stability, Handling and Use of Liquid Fuels to be held 16-20 October 2011 at the Hyatt Regency in Sarasota, Florida USA. The organization of that conference will be in the capable hands of our first Vice Chair, Anthony Kitson-Smith. A Call for Papers will be sent out in mid-November.

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1st Vice Chair's Article
By Anthony Kitson-Smith, ExxonMobil Aviation

As my first article as the 1st Vice Chair of IASH, I would like to tell you about my experience in running a second London Marathon – and along the way helping two very important charities.

I guess it is a good place to ask the question why people run Marathon's. Are they running away or running towards something? Or are they just crazy? Most of my friends would suggest the latter in my case, and there has to be an element of madness in taking on a 26 mile run (42 kilometres for the metric minded) when you're over 50. Having done it once, knowing what it involves, you definitely have to be mad to do it again, and thereby hangs this story.

In 2008 I ran my first Marathon for charity, and raised over $8,000 for poor and disadvantaged people around the world. I wanted to give something back having seen the disparity in the world – as a frequent business traveller living the "high life" relatively speaking in comparison to many that I have seen in my travels. We take for granted so many things that millions of people around the world don't have (and I'm not talking about i-pods)…….food every day, clean water, light, heat, clothes, shoes, somewhere to call home.

So in 2008, after I had run the London Marathon, I said I would never do it again. My wife and children were so inspired by my effort that they decided to run in 2009, so out of "sympathy" I said I'd run with them. We all went into the ballot and I was successful, they weren't – so much for sympathy! Last year was a little busy, so I postponed my run to this year and thought that I might help some other charities. I was moved by some of the smaller, less well-known organisations that nevertheless do fantastic work. In the end, as I couldn't choose between them, I decided to run for both the Stroke association and WaterAid. Most of us will be familiar with the devastating impact of a stroke on both the person, but also their family. However, we may not be aware of how many millions of people in the developing world do not have access to clean water and indeed, have to walk on average 3 to 4 miles a day just to get the water they need to live! WaterAid works in some of the poorest countries in the world providing access to clean water and also sanitation – a real life changer and lifesaver.

I tend to run a few times a week anyway, just for health…..but at Christmas 09, the training started in earnest – this means ramping up the weekly mileage to about 25 in January 30 in February and nearly 40 miles a week in March. You also think about doing other sensible things like watching what you eat and cutting out the booze…….then the reality of frequent business travel kicks in and you accept that the world record is something for "next time". The training was going well until mid March, and then when packing to check out of a hotel in Dubai, I caught my little toe on a chair in the room and broke it. One thing about Marathon runners – and it is part of the psychology – you never give up. Two days later I was running again. It hurt! 40 miles training a week became a bit of a dream, but I was getting about 20 miles in, so it still seemed possible.

Then in April, I found myself in Kuala Lumpur, a week before the race and there was some volcano in Iceland that had closed half of European airspace. My return flights got cancelled and I was faced with watching the Marathon on TV. The ExxonMobil travel people worked a bit of a miracle and I found myself travelling back to Dubai, then Paris, then the Eurostar train to London, just in time to register for the race. The weathermen said it would be a hot day! In England, never trust the weathermen. It rained and was cold for the first hour and never really got hot – I was grateful.

The race itself is quite a spectacle. Every mile of the route is lined with cheering crowds and it is great to have all this support. The start is very very busy and you cannot really run easily at your pace, but after a few miles, the runners spread out a bit and it is better. You have to watch your footing around the drinks stations (almost every mile) as the discarded water bottles are a hazard. You find yourself running with many thousands of people, almost all are raising money for charity (I think the London Marathon is the largest single fund raising event in the world – this year the money was about US$ 100 million – not bad!!) There are just runners – like me – and then there are the real heroes in my view – the runners in costumes. There were some running in Rhinoceros costumes for save the Rhino, there was a young lady running in a 2 metre tall beer bottle raising money for children's cancer charity, there were Firemen running in full fire-fighting kit (including the breathing apparatus and air cylinder….., there were even about 40+ people roped together running as a team. Just running the marathon is enough. To run in these get-ups is something else. I cannot imagine how they do it.

So how did it go? Well, OK up to about 20 miles and then the lack of training in the last few weeks really hit hard. I had been running on about a 4-hour finish, but "the dreaded wall" appeared at 20 miles and I had to accept that walking for a mile was the only way to continue. After the walk, it was possible to run again, but only another mile and then another shorter walk. At this point, with just over three miles to go, I recognised where I was in London and thought that the finish was close, so I set off running again. Slowly. The last couple of miles is running along the embankment in London towards the Houses of Parliament in the distance. This is the home stretch and it is a great feeling. Then at the Houses of Parliament, you take a right turn up towards Buckingham Palace and you are nearly there. Once you get to the roundabout in front of the Palace, you only have about 150 yards to go and now the finish is in sight. This is where you finally know you are going to make it. Everything comes together and you "sprint" for the line. The feeling when you cross the line is simply indescribable. Very emotional, the body is sending you big thank-you signals as you have stopped the torture, but also you realise just how big a deal it is to run the distance.

So what happened next? After a shower and bit of a party with both of the charities (raised about US$ 2500 for each one –AND a very big thank-you to all of my sponsors – I really could not have done this without you.) I was back to the airport and on a plane to Hong Kong! Not an ideal way to spend the night after running a marathon, but a very good talking point in the meeting I had to go to. It takes about 3 to 4 weeks for the tiredness in the legs to finally wear off, so now I am back in training again!! I stupidly agreed with a Greek friend last year to run the Athens Marathon in October. (Well it is the 2500 year anniversary of the original run in ancient Greece.) The man who ran in ancient Greece wanted to tell the leaders in Athens that the Greeks had beaten the Persians in a battle. He gave the message and died. Perhaps I now understand this……..my Greek friend showed me the "course" of the classic Athens marathon. You start in Marathonis……and the first 20 miles are all up hill!! Hopefully, I'll still be around for IASH – Sarasota in October 2011 to Chair the Conference. No more Marathons though!!

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Inside

IASH NEWS

IASH On-Line Library

By Shirley Bradicich
IASH Administrator

The IASH On-Line library is up and running and can be accessed by all members through the IASH web site (www.iash.net) by following the link to the IASH Library. All members should have received an Access ID and Password via email earlier this year. If you did not receive your ID and Password, please notify Shirley Bradicich via email at sbradicich@iash.net and she will forward it to you. The library includes all past Conference Proceedings starting in 2000 through 2009, as well as all IASH Newsletters.

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Monitoring the IASH Website

By Maurice LePera
LePera and Associates

Monitoring the Internet traffic at the IASH Website (http://www.iash.net) provides a means to gauge the activity levels and interest of those viewers who frequent the website. This is often referred to as Web analytics which is defined by Wikipedia as the measure, collection, analysis and reporting of Internet data for purpose of understanding and optimizing web usage. The monitoring of web analytics for the IASH Website began in April 2005. A means to analyze the statistics for the IASH Website, such as number of times the website was accessed, number of pages that were viewed, etc., became available from the support contractor for IASH, Encipher Design Studio. This analysis provided some interesting statistics. The metrics measured at that time were numbers of hits, visits, unique visits, and number of pages viewed. These web statistics were generated each quarter and continued every quarter until March 2007 when they ended due to the change in support contractors. With the new support contractor Meeting Expectations, a new methodology evolved for generating the quarterly statistics for the IASH Website.

The former system mentioned above employed metrics such as number of hits, number of visits, number of unique visits, and number of page views. With the new system that uses Google Analytics (http://www.google.com/analytics/), the following metrics are now being utilized: number of visits, number of pageviews, bounce rate, new versus returning visitors and click or click-paths. These metrics are viewed by Google Analytics as being the more informative in evaluating website traffic. Google Analytics does not measure the number of hits as they state the number of hits received by a website is frequently cited to assert its popularity, but that this number is extremely misleading and dramatically over-estimates popularity. A single web-page typically consists of multiple (often dozens) of discrete files, each of which is counted as a hit as the page is downloaded, so the number of hits is really an arbitrary number more reflective of the complexity of individual pages on the website than the website's actual popularity. The total number of visitors or page views provides a more realistic and accurate assessment of popularity.

Using the metrics provided by Google Analytics, quarterly summaries for the months of **January** through **March 2010** have been generated. To assist in the better understanding of these metrics, the definitions taken from the Glossary provided in Google Analytics are given below.

Visit - A period of interaction between a visitor's browser and the IASH Website, ending when the browser is closed or shut down, or when the user has been inactive on that site for a specified period of time. This is the most basic measure of how well the IASH Website is communicating to its viewers. Visits are often referred to as sessions.
Page – Any file or content delivered by a web server that would be considered a web document.
Pageview - A pageview is an instance of a page being loaded by a browser. Pageviews represent the number of individual pages that were viewed on the IASH Website for the stated period.
Bounce Rate - The percentage of single-page visits or visits in which the person left the IASH Website from the entrance (landing) page. High bounce rates indicate the viewer left the initial front page after viewing it as the information contained was not felt to be relevant or of interest to the viewer. Ideally, lower bounce rates indicate a greater interest on the part of the viewer.
New Visitor - A visitor is designated as new when any page on the IASH Website has been accessed for the first time by a web browser. A high number of new visitors suggest that the IASH Website is successful in attracting viewers to the site.
Returning Visitor - A visitor is designated as returning when the _utma cookie from your domain exists on the browser accessing the IASH Website. A high number of returning visitors suggests that the website content is sufficiently engaging to bring back repeat viewers.
Clicks - A Click refers to a single instance of a user following a hyperlink from one page in the IASH Website to another. A growing community of web site editors use “click analytics” to analyze their web sites.

The quarterly summaries for the IASH Website are listed in the tables below.

Month	# of Visits	# of Pageviews	Bounce Rate	New vs. Returning Visitors
January	**503**	**1,634**	**64.81%**	**320 / 183**
February	**306**	**748**	**68.63%**	**245 / 61**
March	**443**	**1,038**	**63.88%**	**305 / 138**

Percent Clicks Cumulatively January through March

IASH Web Pages	**Percent Clicks on each Link**
About IASH	3.7%
Conferences	15.8%
Sponsorship	2.6%
Resources	9.3%
IASH Library	6.5%
News	2.4%
Awards	1.4%
Membership	2.2%
Contact Us	5.4%

Countries Accessing the IASH Website

Visits for **January**		Visits for **February**		Visits for **March**	
United States	250	United States	138	United States	253
United Kingdom	39	United Kingdom	35	United Kingdom	28
Brazil	28	Brazil	15	Brazil	20
Germany	13	Germany	10	France	15
Australia	12	France	9	South Korea	9
China	11	Spain	8	China	8
France	11	India	8	Sweden	8
Canada	10	Canada	7	Canada	8
Saudi Arabia	9	Japan	6	Germany	7
Israel	8	China	6	South Africa	7
Others	112	Others	104	Others	80
Totals	**503**	**Totals**	**306**	**Totals**	**433**

Percent Clicks on each Link during January through March

IASH Web Pages	**Percent Clicks** for **January**	**Percent Clicks** for **February**	**Percent Clicks** for **March**
About IASH	0.8%	0	0
Conferences	3.8%	2.2%	8.0%
Sponsorship	1.1%	2.5%	0.7%
News	1.1%	7.6%	2.9%
Awards	0.3%	1.3%	0
Membership	1.9%	3.8%	2.2%
Contact Us	4.0%	6.3%	8.7%
Mark Your Calendar	0	0	24.0%
IASH Resources:			
FAQ	0.3%	0	2.9%
Specifications	3.8%	8.9%	8.7%
Technology etc.	2.2%	2.5%	0.7%

IASH Library: Newsletters Links Conferences	 1.1% 0.8% 1.9%	 7.6% 1.3% 6.3%	 2.9% 0.7% 5.1%
Logos	0.8%	1.3%	0.7%

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IASH MEMBER NEWS

Submissions for articles in "IASH Member News" can be directed to Shirley Bradicich at sbradicich@iash.net. Please forward them by 15 November 2010.

We are pleased to announce that IASH has received $2,000 for Supporting Membership from the Federal Aviation Administration for 2010. The FAA has appointed Mr. Mark Rumizen to serve on the IASH Board of Directors.

The Board would like to express its appreciation to Mr. Ubaidallah AlGhamdi for his many years of service to the Board and Supporting Membership from his company, The Arabian Fuels Technology Center. Mr. AlGhamdi felt it was time for him to resign from the IASH Board of Directors.

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TECHNICAL NEWS

Foreign Fuel Specifications

By Maurice LePera
LePera and Associates

Since the principal focus and involvement within the IASH has been and continues to be centered on combustible fuel products, the easy access of fuel specification from within the United States as well as those from foreign countries became one of the goals to achieve early on. An ability to access these different fuel specifications was of particular importance in view of the fact that IASH is an international association. As a result of this, the IASH website has listed under its Resources, a listing of fuel specifications from twelve countries as well as from three international organizations; namely, ISO, NATO, and CEN.

Seeking to add additional websites for other foreign fuel specifications, a recent effort has generated five additional websites providing information on fuel specifications from France, United Kingdom, Denmark, Finland, and Sweden. The listing of individual fuel specifications from these five countries are listed below as well as the url for accessing each specification. These additions to the listing of fuel specifications will be added to the IASH website shortly.

Association Francaise de Normalization (AFNOR) Fuel Specifications

NF ISO 8216-99, Petroleum Products – Fuels (Class F) – Classification – Part 99: General, November 2002.
NF ISO 8216-2, Petroleum Products – Fuels (Class F) – Classification – Part 2: Categories of Gas NF ISO 8216-1, April 1987.
8216-1, Petroleum Products – Fuels (Class F) – Classification – Part 1: Categories of Marine Fuels and, Turbine Fuels for Industrial and Marine Applications, April 2006.
NF ISO 4261, Petroleum Products – Fuels (Class F) – Specifications of Gas Turbine Fuels for Industrial and Marine Applications, October 1994.
M15-011, Liquid Mineral Fuels – Properties of Heavy Fuel Oil – Oil Number 2, August 1982.
M15-088, Liquid Mineral Fuels – Performance Requirements for Fuel Oil – July 1988.
NF EN 228, Automotive Fuels – Unleaded Petrol – Requirements and Test Methods, January 2000.
NF M15-021, Fuels – Automotive Fuels – Diesel – Characteristics of Water-In-Diesel fuel Emulsions (WDE), February 2002.
XP M15-029, Automotive Fuels – Petrol – Super Ethanol – Requirements and Test Methods, December 2006.
NF EN 14214, Automotive Fuels – Fatty Acid Methyl Esters (FAME) for Diesel Engines – Requirements and Test Methods, April 2004.
NF EN 14274, Automotive Fuels – Assessment of Petrol and Diesel Quality – Fuel Quality Monitoring System (FQMS), April 2004.
NF EN 590 Automotive Fuels – Diesel – Requirements and Test Methods, January 2000.
NF EN 14275, Automotive Fuels – Assessment of Petrol and Diesel Quality – Sampling for Retail Site Pumps and Commercial Site Fuel Dispensers, May 2004.
NR EN 228, Automotive Fuels – Unleaded Petrol – Requirements and Test Methods, April 2004.
NF EN 590, Automotive Fuels – Diesel – Requirements and Test Methods, April 2005.

Click HERE to access these AFNOR specifications on the Internet.

British Standards Institute (BSI) Fuel Specifications

BS 2869:2006, Specification for Fuel Oils for Agricultural, Domestic, and Industrial Engines.
BS 4040:2001, Specification for Leaded Petrol (Gasoline) for Motor Vehicles.
BS 6843-2:1988, Classification of Petroleum Fuels. Gas Turbine Fuels for Industrial and Marine Applications.
BS 6843-3:1988, Classification of Petroleum Fuels. Liquefied Petroleum Gases.
BS 7800:2006, Automotive Fuel. High Octane (Super) Unleaded Petrol.
BS ISO 8216-1:2005, Classification of Petroleum Fuels. Marine Fuels.
BS ISO 8217:2005, Specification for Petroleum Fuels for Marine Oil Engines and Boilers.
BS CWA 15145:2004, Automotive Fuels. Water in Diesel Fuel Emulsions for use in Internal Combustion Engines. Requirements and Test Methods.
BS CWA 15293:2005, Automotive Fuels. Ethanol E85. Requirements and Test Methods.
BS DD CEN/TS 15359:2006, Solid Recovered Fuels. Specifications and Classes.
BS 05/30136736 DC:2005, Reciprocating Internal Combustion Engines, Exhaust Emission Measurements, and Test Fuels.
BS 06/30147976 DC:2006, Automotive Fuels. Ethanol as a Blending Component for Petrol. Requirements and Test Methods.

BS 08/30172824 DC:2008, Automotive Fuels Fatty Acid Methyl Ester (FAME) Fuel and Blends with Diesel Fuel. Determination of Oxidation Stability by Accelerated Oxidation Method.

Click HERE to access the British Standards Institute on the Internet.

Danish Fuel Specifications

DS/CEN/TR 15367-1:2007, Petroleum products - Guide for good housekeeping - Part 1: Automotive diesel fuels.
DS/CEN/TR 15367-2:2007, Petroleum products - Guide for good housekeeping - Part 2: Automotive petrol fuels.
DS/CWA 15145:2006, Automotive fuels - Water in diesel fuel emulsions for use in internal combustion engines - Requirements and test methods.
DS/EN 14156:2003, Derivatives from coal pyrolysis - Coal tar based oils: Coal tar fuel - Specifications and test methods.
DS/EN 14213/AC:2004, Heating fuels - Fatty acid methyl esters (FAME) - Requirements and test methods.
DS/EN 14213:2003, Heating fuels - Fatty acid methyl esters (FAME) - Requirements and test methods.
DS/EN 14214/AC:2007, Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods.
DS/EN 14274:2003, Automotive fuels - Assessment of petrol and diesel quality - Fuel quality monitoring system (FQMS).
DS/EN 15376:2008, Automotive fuels - Ethanol as a blending component for petrol - Requirements and test methods.
DS/EN 228/AC:2006, Automotive fuels - Unleaded petrol - Requirements and test methods.
DS/EN 590/AC:2006, Automotive fuels - Diesel - Requirements and test methods.

Click HERE to access the Danish Specifications on the Internet.

Finnish Standards Association (SFS) Fuel Specifications

SFS-KASIKIRJA 58-1 (2005), Liquefied Petroleum Gas and Natural Gas. Administrative Stipulations and Standards. Part 1: Administrative Stipulations.
SFS-KASIKIRJA 58-2 (2005), Liquefied Petroleum Gas and Natural Gas. Administrative Stipulations and Standards. Part 2: Standards for Liquefied Petroleum Gas. Industrial Use.
SFS-EN 228 (2004), Automotive Fuels. Unleaded Petrol. Requirements and Test Methods.
SFS-EN 589:en (2004), Automotive Fuels. LPG. Requirements and Test Methods.
SFS-EN 590:en (2004), Automotive Fuels. Diesel. Requirements and Test Methods.
SFS 5875:en (2000), Solid Recovered Fuel. Quality Control System.
SFS-EN 13856:en (2002), Minimum Requirements for the Content of the User Manual for Automotive LPG Systems.
SFS-EN 14156:en (2003), Derivatives for Coal Pyrolysis. Coal Tar Based Oil: Coal Tar Fuel. Specifications and Test Methods.
SFS-EN 14213:en (2004), Heating Fuels. Fatty Acid Methyl Esters (FAME). Requirements and Test Methods.
SFS-EN 14214/AC:en (2007), Automotive Fuels. Fatty Acid Methyl Esters (FAME) for Diesel Engines. Requirements and Test Methods.

SFS-EN 14274/AC:en (2004), Automotive Fuels. Assessment of Petrol and Diesel Fuel Quality. Fuel Quality Monitoring System (FQMS).
SFS-EN 14275:en (2004), Automotive Fuels. Assessment of Petrol and Diesel Fuel Quality. Sampling for Retail Site Pumps and Commercial Site Fuel Dispensers.
CEN/TS 14961:fi (2005), Solid Biofuels. Fuel Specifications and Classes.
CEN/TS 15234:fi (2006), Solid Biofuels. Fuel Quality Assurances.
CEN/TS 15359:fi (2006), Solid Recovered Fuels. Specification and Classes.
CEN/TS 15367:en (2006), Petroleum Products. Automotive Diesel Fuels. Guide for Good Housekeeping.
CEN/TS 15367-1:en (2006), Petroleum Products. Automotive Diesel Fuels. Guide for Good Housekeeping. Part 1: Automotive Petrol Fuels.
CEN/TS 15367-2:en (2006), Petroleum Products. Automotive Diesel Fuels. Guide for Good Housekeeping. Part 2: Automotive Diesel Fuels.

Click HERE to access the Finnish fuel specifications on the Internet.

Swedish Standards Institute (SIS) Fuel Specifications

SS-EN 228:2006, Automotive Fuels – Unleaded Petrol – Requirements and Test Methods, May 8, 2006.
SS-EN 589:2006, Automotive Fuels – LPG – Requirements and Test Methods, May 8, 2006.
SS-EN 590:2006, Automotive Fuels – Diesel – Requirements and Test Methods, May 8, 2006.
SS-EN 14213, Heating Fuels – Fatty Acid Methyl Esters (FAME) - Requirements and Test Methods, December 5, 2003.
SS-EN 14214, Automotive Fuels – Fatty Acid Methyl Esters (FAME) for Diesel
Engines - Requirements and Test Methods, December 3, 2007.
SS-EN 14274, Automotive Fuels – Assessment of Petrol and Diesel Quality – Fuel Quality Monitoring System (FQMS), October 31, 2003.
SS-CEN/TS 15359:2007, Solid Recovered Fuels – Specifications and Classes, January 18, 2007.
SS-CEN/TR 15367:2006, Petroleum Products – Automotive Diesel Fuels – Guide for Good Housekeeping, September 21, 2006.
SS-CEN/TR 15367-1:2007, Petroleum Products – Guide for Good Housekeeping –
Part 1: Automotive Diesel Fuels, April 19, 2007.
SS-CEN/TR 15367-21:2007, Petroleum Products – Guide for Good Housekeeping –
Part 2: Automotive Petrol Fuels, April 19, 2007.
SS-EN 15376:2007, Automotive Fuels – Ethanol as a Blending Component for Petrol – Requirements and Test Methods, January 17, 2008.
SS 155422:2006, Automotive Fuels – Unleaded Petrol of Environment Class 1 – Requirements and Test Methods, November 6, 2006.
SS 155480:2006, Automotive Fuels – Ethanol E85 – Requirements and Test Methods, August 17, 2006.

Click HERE to access the Swedish fuel specifications on the Internet.

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New Developments in Global Aviation Fuel Handling Equipment Standards

By Martin Hunnybun
Energy Institute

Effective 30 June 2010, the Energy Institute (EI) will take over as the sole provider of a portfolio of equipment standards and operational recommended practices to facilitate the safe and efficient handling of aviation fuel worldwide.

For over 50 years the EI has provided publications for use by the international aviation fuel handling industry. Over the last decade, 15 of these titles have been produced and published jointly with the American Petroleum Institute (with a further six titles published by EI only, and two by API only). These include the well known laboratory qualification specifications for filters (e.g. 1581 5th edition for filter/water separators and 1583 6th edition for filter monitors).

After an organisational review, API has confirmed the responsibility for the aviation fuel handling portfolio will be transferred to the EI.

The jointly branded titles will be superseded by technically identical EI reprints (document reference numbers and edition numbers will remain the same), made available through the EI only (www.energypublishing.org).

The EI is committed to continue to provide the global forum for the standardisation of aviation fuel handling equipment, and operational recommended practices, ensuring that they reflect the consensus agreement of international technical specialists and stakeholders.

The equipment standards in particular are followed worldwide by manufacturers, and adopted by international airlines, major and national oil companies, into-plane companies and aviation fuel hydrant operators.

The use of equipment that meet the standards is mandated in operational documents such as those provided by the Air Transport Association of America (ATA) and the Joint Inspection Group (JIG), and referenced in the International Air Transport Association (IATA) *Guidance materials for aviation turbine fuels specifications*.

The EI will continue to maintain and develop the standards, and all users of the documents are encouraged to visit **www.energypublishing.org** for details of latest editions, reaffirmations, withdrawals and addenda.

The following FAQs will hopefully provide clarification on the transition, but if you would like any further information on the EI aviation fuel-handling portfolio please contact Martin Hunnybun mh@energyinst.org

Frequently Asked Questions

Q1: What will be the difference between API/EI 15xx and EI 15xx (of the same edition)?

A: API branding will have been removed. The technical content will remain identical.

Q2: If I have already purchased API/EI 15xx do I need to purchase the EI rebranded version?

A: No. The technical content will be identical, unless a new edition has been produced (e.g. EI 1583 6th edition (laboratory testing of filter monitors) and EI 1582 2nd edition (similarity for filter/water separators)).

Q3: If an operational document (e.g. ATA 103, JIG 1, 2, 3) references the use of equipment that meets API 15xx, or API/EI 15xx (e.g. 1581), does that document require revision to update the reference to EI 15xx?

A: The reference in the operational document will be incorrect from 30 June 2010. It is recommended that as documents that reference the former API/EI portfolio are updated, the references should be updated to EI 15xx.

Q4: Will EI publications remain relevant and valid in North America?

A: EI will continue to fully engage with international stakeholders, including those in the US, producing publications that are applicable globally.

Q5: Will EI publications be as technically robust as API/EI publications?

A: The same industry specialists/stakeholders will continue to provide input to the EI publication development process, which is open to any technical specialists wishing to contribute.

Q6: Is the way the EI produces publications different to API?

A: No. For the aviation fuel handling documents, stakeholder input to the content has been in accordance with API procedures, and this will continue.

Q7: If I am a North American operator will I have to follow EI publications/use equipment tested in accordance with EI laboratory testing publications in future?

A: The use of any EI (or API) publication is optional. Their use only becomes mandatory (anywhere in the World) if they are referenced in another publication that has to be complied with under contract (e.g. ATA 103, JIG 1,2,3), or in regulation/legislation. If you are contracted to follow ATA 103, and that document mandates the use of filter/water separators that meet EI 1581 5th edition, then only that equipment can be used.

Q8: If I have equipment in operations that is marked as being compliant with an API/EI or API publication does the equipment marking need to be changed?

A: No. Inspectors (e.g. from JIG, airlines) have been briefed on the transition to EI publications. It is understood that API markings on equipment will continue to be seen in the field for many years. Over time it is expected that API branding of equipment will diminish.

Q9: API used to operate a scheme for the witnessing of filter qualification tests. What has happened to that?

A: The scheme is no longer being offered by API. The EI is implementing a similar scheme to provide witnesses for filter qualification tests.

Aviation Fuel Handling Titles

General

EI 1540 *Design, construction, operation and maintenance of aviation fuelling facilities*, 4th edition

EI 1541 *Performance requirements for protective coating systems used in aviation fuel storage tanks and piping*, 1st edition

EI 1542 *Identification markings for dedicated aviation fuel manufacturing and distribution facilities, airport storage and mobile fuelling equipment*, 8th edition

EI 1585 *Guidance in the cleaning of aviation fuel hydrant systems at airports*, 2nd edition

EI 1594 *Initial pressure strength testing of airport fuel hydrant systems with water*, 2nd edition

EI 1597 *Procedures for overwing fuelling to ensure delivery of the correct fuel grade to an aircraft*, 1st edition

EI HM 20 *Meter proving: Aviation fuelling positive displacement meters*, 1st edition

Equipment (excluding filtration)

EI 1529 *Aviation fuelling hose and hose assemblies*, 6th edition

EI 1584 *Four-inch hydrant system components and arrangements (hydrant pit valves and intake couplers)*, 3rd edition

EI 1598 *Considerations for electronic sensors to monitor free water and/or particulate matter in aviation fuel*, 1st edition

EI Research Report: *Review of methods of bonding a hydrant dispenser (servicer) to an aircraft for refuelling*

Filtration equipment

EI 1550 *Handbook on equipment used for the maintenance and delivery of clean aviation fuel*, 1st edition

EI 1581 *Specification and qualification procedures for aviation jet fuel filter/separators*, 5th edition

EI 1582 *Specification for similarity for EI 1581 aviation jet fuel filter/separators*, 1st edition

EI 1583 *Laboratory tests and minimum performance levels for aviation fuel filter monitors*, 6th edition

EI 1590 *Specifications and qualification procedures for aviation fuel microfilters*, 2nd edition

EI 1596 *Design and construction of aviation fuel filter vessels*, 1st edition

EI 1599 *Laboratory tests and minimum performance levels for aviation fuel dirt defence filters*, 1st edition

EI Research Report: *Electrostatic discharges in 2-inch fuel filter monitors*

EI Research Report: *Electrostatic discharges in 2-inch aviation fuel filter monitors Phase 2: Properties needed to control discharges*

EI Research Report: *Investigation into the effects of lubricity additives on the performance of filter/water separators*

North American fuel handling

API 1543 *Documentation, monitoring and laboratory testing of aviation fuel during shipment from refinery to airport*, 1st edition

API 1595 *Design, construction, operation, maintenance, and inspection of aviation pre-airfield storage terminals*, 1st edition

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RESEARCH NOTES

New Fuels for the Fight: The U.S. Air Force's Actions and Objectives in Alternative Fuels

by Beatriz Rodriguez, Elizabeth Christensen, and Thomas Bartsch,
U.S. Air Force Alternative Fuels Certification Office

In 2007, the United States Air Force bolstered its commitment to power its fleet with non-petroleum based fuel with two important acts: it certified the B-52 to fly on a synthetic fuel blend and it stood up the Alternative Fuels Certification Office (AFCO). With the Secretary of the Air Force leading the way, Air Force leaders have recognized the national security implications of being dependent on foreign oil, and the creation of the AFCO was a vital part of the Secretary's Assured Fuels Initiative. Located at Wright-Patterson Air Force Base as a part of the Aeronautical Systems Center (ASC), the AFCO was chartered to manage the certification of all Air Force platforms (40+ aircraft), support equipment, and base infrastructure on a 50/50 blend of synthetic paraffinic kerosene (SPK) and the current military baseline fuel, JP-8, by the start of 2011.

In three years since the program's inception, the AFCO has accomplished the first U.S. flight of the SPK blend fuel using a B-52, the first transcontinental SPK flight using a C-17, the first supersonic SPK flight using a B-1, and additional aircraft demonstrations including the F-15, F-22, KC-135, T-38, C-5, C-130, A-10, F-16, and T-6. The AFCO itself does not have the authority to certify systems, but rather supports the certification efforts of a system's Single Manager, the responsible authority for airworthiness and operational safety, suitability, and effectiveness. Thanks to the support of countless engineering, test, and logistics personnel in the system program offices, AFCO's SPK program is on track to meet the Air Force's 2011 goal of full fleet certification.

The backbone to all this work has been a robust, handbook-based process to investigate airworthiness, safety of flight, materials compatibility, and a host of other areas on each system. The handbook, MIL-HDBK-510, was created through AFCO collaborations with the Air Force Research Laboratory (AFRL), the Air Force Petroleum Agency, and many other stakeholders. Formally implemented by ASC for USAF use and available for information for the other U.S. military services, the handbook documents a standardized process which can be used for the certification of other aircraft and related systems for not only the SPK fuel blend, but also for other newly identified aviation fuel types as well as for fuel additives.

As a result of the successes of the SPK program, a new version of the tri-service JP-8 specification that includes SPK blend fuel was published in April 2010. The revised specification, MIL-DTL-83133G, retains the same fuel properties as the original, but allows the fuel to be made not only from petroleum feed stock but also from up to 50% generic Fischer-Tropsch-produced SPK, derived from coal, natural gas, or biomass feed stocks.

Using the processes developed and the lessons learned during the SPK certification program, the AFCO has been directed to begin certification efforts on fuel made from biomass, also called hydroprocessed renewable jet (HRJ) fuel. Working with AFRL's Propulsion Directorate, which investigated many prospective HRJ feed stocks, AFCO has initiated a program to test and certify fuel from two primary feed stocks, the camelina plant and animal fat-based tallow. As with SPK, fuel from these feed stocks can be blended with JP-8 to produce a fuel that fully meets all JP-8 specification properties.

A significant milestone was achieved in March 2010 when an A-10 at Eglin Air Force Base became the first aircraft ever to fly with all engines powered by an HRJ blend. The AFCO plans to pursue a streamlined “pathfinder” approach for the full-fleet certification of HRJ fuel, wherein a few representative aircraft will fly demonstration programs and the data gathered will be used by platform Single Managers to certify other aircraft by similarity where applicable. Further efficiencies will be realized through cooperation with the Army and Navy as well as the Commercial Aviation Alternative Fuel Initiative (CAAFI). Current plans for the remainder of 2010 include HRJ flights on the F-15, C-17, and F-22 aircraft, with a high-altitude pathfinder to follow. The Air Force’s goal is to complete fleetwide certification of HRJ fuel in 2013.

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ALFA-BIRD - Alternative Fuels and Biofuels for Aircraft Development

http://www.alfa-bird.eu-vri.eu/

Laurie Starck and Nicolas Jeuland (IFP, France)
Marina Braun-Unkhoff and Patrick Leclerq (DLR, Germany)
Paul Bogers (Shell, Netherlands)
Olivier Salvi (EU-VRi, Germany)based on a collective work in the Alfa-Bird project

The European project ALFA-BIRD is dedicated to the evaluation of the most promising alternative fuels in aeronautics, at a middle, short and long term.

Summary

In the ALFA-BIRD program, the fuel selection process is divided into two steps. The consortium has completed the first step, which consisted in evaluating 12 blends in terms of their quality as jet fuel based solely on standard characterization. These 12 blends were: FSJF[1], FT[2]-SPK[3], blends of FT-SPK with naphthenic cut, with hexanol, with furane and, with FAE[4], in different amounts. These results were used for the selection of the four fuels that will be tested in detail in the second phase: the assessment of the suitability of alternative fuels for aircraft. The four fuels selected are FSJF, FT-SPK, a blend of FT-SPK and 50% naphthenic cut, and a blend of FT-SPK and 20% hexanol. This fuel matrix offers the possibility to evaluate the potential of different chemical families, which are paraffinic compounds, naphthenic compounds and, oxygenated compounds. This is also representative of a short, middle, and long term view.

Introduction

[1] FSJF for Fully Synthetic Jet Fuel
[2] FT for Fischer-Tropsch
[3] SPK for Synthetic Paraffinic Kerosene
[4] FAE for Fatty Acid Ester

Purpose of the article

The European project ALFA-BIRD is dedicated to the evaluation of the most promising alternative fuels in aeronautics, at a middle, short and long term.

The purpose of this article is to explain the choice of the fuels that will be tested in the second phase of the project. This phase is concerned with a detailed assessment procedure that covers three main areas, i) technical requirements with respect to the full flight envelop, ii) material compatibility for aircraft and engine fuel systems and, iii) safety standards.

The selection of the fuel is based on the results of the analysis based on ASTM D7566 (Jet A-1 and 100% SPK) of the initial fuel matrix.

ALFA-BIRD's mission and consortium

ALFA-BIRD (Alternative Fuels and Biofuels for Aircraft Development) is a project partially funded by the EU in the 7th Framework Programme for Research and Technological Development, under grant n° 213266. It started in July 2008 and will last four years. Its objective is to investigate and develop a variety of alternative fuels including biofuels that could gradually replace crude oil based Jet A-1/Jet A currently in use in aeronautics. The main motivation is the need to ensure a sustainable growth of the civil aviation with regard to the impact of fossil fuels on climate change and air quality, and also in the context of oil prices that are highly volatile and increasing in the long term.

One of the main challenges in the project is to propose new fuels that meet the very strict safety and operational constrains in aviation (e.g. safe flight under very cold conditions). Furthermore, these proposed new fuels should be compatible with current civil aircraft, which is a must due to their long lifetime of almost 50 years. To address this challenge, ALFA-BIRD gathers a multi-disciplinary consortium composed of 23 members[5] with key industrial partners from aeronautics (engine and aircraft OEM) and fuel industry, as well as from research organizations covering a large spectrum of expertise in such fields as biochemistry, refinery, combustion, aircraft systems or industrial safety, to name only a few. The ALFA-BIRD program is consequently dedicated to the selection and the evaluation of the most promising alternative fuels with short to long term perspective. In order to do so, the expertise of all partners will be gathered, and the evaluation will be done on a technical basis: physical properties, combustion behaviour, material compatibility, security aspects, but also on economical and environmental aspects (life cycle analysis).

Selection process of alternative fuels for aviation

As planned originally in the ALFA-BIRD program, the fuel selection process is divided into two steps. The consortium has now completed the first step, which consisted in evaluating 12 blends in terms of their quality as jet fuel based on standard characterization (see Table 1). Shell is acknowledged for conducting this first phase of analysis. This fuel matrix consisted of a range of blends of synthetic fuels with novel organic components and bio-derived components, currently outside Jet fuel specification compositional boundaries. The properties of these fuels were tested against the industry jet fuel specification ASTM D7566, for finished Jet A-1 and 100% Synthetic Paraffinic Kerosene (SPK) components.

Fuel number	Description (volume % blends)
1	FSJF

[5] Eu-VRi, Airbus, AVIO, CNRS, Technologica, Dassault, DLR, INERIS, LISBP, IFP, LESAFFRE, MTU, ONERA, ROLLS-ROYCE, SASOL, SHELL, SNECMA, USFD, Universitaet Karlsruhe, Graz University of Technology, University of Toronto

2	FT-SPK
3	FT-SPK + 50% Naphthenic cut
4	FT-SPK + 20% Hexanol
5	FT-SPK + 10% Furane
6	FT-SPK + 20% Furane
7	FT-SPK + 30% Furane
8	FT-SPK + 10% FAE
9	FT-SPK + 20% FAE
10	FT-SPK + 30% FAE
11	FT-SPK + 50% HVO
12	FT-SPK + 75% HVO

Table 1: Description of the 12 blends used in SP1

This proposed fuel matrix of 12 Jet-fuel candidates is built around three axes, covering a wide range of alternative fuels. Regrouping these alternative fuels by chemical family, we have:

- paraffinic compounds
- naphthenic compounds
- oxygenated compounds.

The paraffinic compounds are stemming from FT synthesis (SPK), HVO[6] or, sugar-to-alkane pathway. The naphthenic compounds represent products that come from direct liquefaction/pyrolysis of coal or biomass. Concerning the oxygenated compounds, the study of their potential use in aeronautics is very original and will be explored in ALFA-BIRD. Each selected chemical family is discussed in the following.

The reference fuel

The selection process adopted in ALFA-BIRD is a direct comparison of each fuel candidate with a well characterized and a certified reference fuel rather than a relative comparison between each candidate. The reference fuel is identical for all tests and all partners.

Jet A-1/Jet A is the conventional fuel for aeronautics. However, this product has a large variability according to the crude oil and the process (sweetening, hydroprocessing, among others), this implies for example a variation in the level of aromatics and sulphur.

ALFA-BIRD has chosen the FSJF from Sasol as the reference fuel for several reasons:

- To place the study in a long-term view
- To have coherence and to be complementary with respect to other EU and international initiatives (SWAFEA[7], CAAFI[8]).
- To have less variability on the reference.

The FSJF is a fully synthetic jet fuel and consists of 50% FT-SPK and 50% of severely hydrogenated coal tar kerosene. This product has a well-defined composition due to the fact that it comes from an identified refinery with a controlled process. Moreover, a synthetic fuel contains

[6] HVO for Hydro treated Vegetable Oils
[7] SWAFEA for Sustainable Way for Alternative Fuel and Energy in Aviation; see www.swafea.eu
[8] CAAFI for Commercial Aviation Alternative Fuels Initiative; see www.caafi.org

inherently less chemical families with a narrower distribution of components within each family. This in turn makes it an adequate reference as it is less prone to source/process-dependent variations.

The paraffinic compounds

A promising alternative fuel is FT-SPK. The Fischer-Tropsch synthesis is described in the following: Raw material (e.g. coal, natural gas, biomass) is broken down at high temperature to basic molecules (CO and H_2 – this mixture is called synthetic gas or syngas), chemically cleaned, and rebuilt to different products (including jet fuel). This process makes mainly straight-chain hydrocarbons (paraffinic compounds). The advantage of this process is the large variability of the sources that could be used. The process is well known nowadays from coal and gas and future development will be to use also biomass or biogenic waste and side products as a feedstock.

FT-SPK[9] is used in ALFA-BIRD as a blending base; consequently, this product is also tested neat in order to have the possibility to clearly identify the fuel impact. FT-SPK used in the ALFA-BIRD project is within SPK specification limits (ASTM[10] D7566). It can be noticed that SPK has no aromatics (less than 0.5% mass), and the ASTM D7566 specifications indicate a minimum of around 8% of aromatics in the final blend (Jet + FT-SPK).

HVO is also a paraffinic product. Its chemical composition and its physical properties are close to FT-SPK ones, provided they meet the same D7566 requirements. The potential of HVO has been explored in ALFA-BIRD by doing standard characterization.

It was decided to choose FT-SPK, representing paraffinic compounds, as the selected fuel for the second phase of ALFA-BIRD, mainly because of the availability of this product, and also, to be complementary with respect to other initiatives (SWAFEA, CAAFI).

The naphthenic compounds

The naphthenic or naphtheno-aromatic compounds can be produced from direct liquefaction of coal (nowadays) or of biomass in the future (sustainable). This kind of molecule has some characteristics that seem to be suitable for jet fuel use in particular good cold flow properties as well as good energy content in volume. Some elements are still to be checked like the behaviour in combustion, the pollutant emissions, and the material compatibility, in agreement to ALFA-BIRD’s mission: to revisit the fuel specifications and reconsider the whole aircraft system composed by the triplet: fuel, engine and ambience.

The main effect of adding naphthenic or naphtheno-aromatic to FT-SPK is to bring the FT-SPK blend into the Jet A-1 specification limits (ASTM D7566), mainly in terms of minimum aromatics contain (8% in volume by IP 156) and density (775 kg/m3 as a minimum by IP 365). This was observed during the first step dedicated to standard characterization with a blend of FT-SPK and 50% of naphtheno-aromatic cut.

Therefore, it seems important to explore the potential of this blend in more detailed tests.

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[9] There are currently no industrial plants for producing BtL, consequently the FT-SPK used in Alfa-Bird is a GtL from Shell. The GtL product is assumed to be similar to a BtL product because the same process is used.

[10] ASTM for American Society for Testing Materials. ASTM D7566 is a new specification for certifying a 50% blend of Jet A-1 and SPK produced from biomass using a Fischer Tropsch process.

The oxygenated compounds

The oxygen presence in the chemical structure is expected to affect key fuel properties including: energy density, volatility, corrosion ability, material compatibility, and combustion properties. It is why the oxygen compounds can not be used as a blending component in a substantial volume. However, one of the interests to have oxygen in the molecule structure could be the reduction of the particulates emissions. Potential oxygenated fuels envisaged in the first step are listed below.

Alcohols

Alcohol - for fuel - is produced from the fermentation of sugars by enzymes. The feedstock might be sugarcane, sugar beet, wheat, barley, or corn. Presently, the process of fermentation cannot make use of the whole biomass, and significant research is underway to improve this. Moreover, the modification of the enzymes to allow the production of other alcohols such as hexanol is an area of research.

The interest – and the need - to use other alcohol in aeronautics instead of ethanol is to fit with specified jet fuel properties such as energy density, flash point or, water solubility among others. Some of these drawbacks can be overcome by the use of higher alcohols (meaning higher carbon number) as some properties are more or less proportional the carbon chain length thus bringing the final blend closer to jet fuel properties.

In conclusion, ethanol is available worldwide, but it presents severe drawbacks. The use of higher alcohols could have a potential, provided that some production pathways are found. Moreover the CO_2 balance could be interesting. Consequently, alcohols can be an alternative fuel for aircraft but in a long term view.

However, alcohol cannot be used as a blending component in a *substantial* volume to avoid an important decrease of the energy content. A blend of FT-SPK and 20% hexanol gives interesting results in standard characterization.

FAE (Fatty Acids Esters)

FAE (Fatty Acid Esters) is commonly referred to as "biodiesel" and is used as blending components for diesel fuel, in accordance with the EU legislation. The name biodiesel has been given to Fatty Acid Esters. The question remains whether FAE could also be considered as a possible alternative fuel to conventional jet fuel.

Esters have chemical and physical properties that are similar to conventional fossil fuel; but these properties depend on the starting material: esters can have different numbers of carbon atoms and varying degrees of unsaturation (number of carbon-carbon double bonds).

Due to their properties, FAE can not be directly used as a blending component for Jet fuels in *substantial* volume.

However, there exists a possibility to improve the properties of FAE for jet fuel use by the selection of the raw material (chain length / unsaturation rate trade-off, use of another type of alcohol for trans-esterification process...). Additionally, FAE presents high availability due to a well known production process and to large production plant investments.

In the first step (standard characterization) of the ALFA-BIRD project, blends of FT-SPK and FAE (10, 20 and 30%) have been produced and analysed. It is observed that the addition of FAE implies an increase in acidity, in corrosion, and poor cold flow behaviour. The addition of FAE in a FT-SPK has a positive effect on the density. Nevertheless, ALFA-BIRD will not explore any deeper the use of this type of compounds (FAE).

Furans

Furans are produced from carbohydrate components that can be found in lignocellulosic biomass, in sugar beet and in sugar beet pulp. The production method is still in the early stages of development and is therefore the subject of several research programmes. In spite of a high density, the cold flow properties as well as the boiling and the flash point of this kind of molecule are in the range of a Jet fuel.

Note that the oxygen content of this molecule that implies a low energy density in mass can be compensated with a high density, and consequently a correct energy density in volume. The material compatibility needs also to be checked.

The potential of furans, more precisely tetrahydrofurfuryl ethyl ether, was explored in ALFA-BIRD – within SP1 tests - by doing blends of FT-SPK with 10, 20 and 30% of furans. Nevertheless, ALFA-BIRD will not explore any deeper the use of furans.

Conclusions

It is clear that oxygenated compounds are not "drop-in" fuels but it is important to study this alternative fuel in a long term view in order to evaluate their potential. From all the oxygenated compounds, it has been decided to select the blend of 20% of hexanol in FT-SPK in order to perform the second step in the selection process.

3. The fuel matrix for SP2 tests: Summary

For all of the reasons mentioned above, it was decided that the following fuels will be tested for the second phase of the ALFA-BIRD project, which consists in the assessment of the suitability of alternative fuels for aircraft. This selection is based on the standard characterization done on the initial fuel matrix (12 blends).

The four fuels proposed for the tests (ignition, combustion, evaporation...) in the second part of the project are:

- **FSJF**
- **FT-SPK**
- **FT-SPK + naphthenic cut (50%)**
- **FT-SPK + hexanol (20%)**

<u>Remark:</u> If there is an opportunity during the run of the project to test some new fuels, this will be done with standard characterization.

Description of detailed tests to be carried out within the 2nd phase of ALFA-BIRD

These detailed tests will be performed in four different work packages focusing on:

(1) Injection and combustion

Experimental behaviour, up to real conditions; Model validation

(2) Engine systems integration

Experimental check of compatibility; Search for improved materials

(3) Aircraft systems integration

Experimental check of compatibility

(4) Safety, standards, regulations
Towards certification (regulations, standardisation)

Concerning injection and combustion, the selected alternative fuels must release the energy necessary to power aircrafts' engines. Therefore, the tests are directly related to the elementary physical phenomena occurring in the aircraft engines: atomization, single droplet and spray evaporation, vapour mixing, ignition, heat release, and combustion, with FSJF as reference. Results collected from these experiments are, for example, the evaporation rates of monodisperse streams of droplets evaporating in different pressure-temperature conditions; auto-ignition delay time, laminar flame speed, and product pattern of the combustion, for a wide range of parameters. These data will enable to work also on chemical models to describe these kinds of characteristic combustion properties.

Concerning the engine systems integration, safety aspects of using the selected alternative fuels will be assessed. Any jet fuel will come into contact with a variety of materials both metallic and non-metallic. Hence, some tests are taken care of the fuel's property to act as a hydraulic fluid and as a heat sink in the engine control system. Therefore, static and dynamic tests will be undertaken on the non metallic materials found within the engine. Also, the effect of the fuels on wetted metals found in the engine will be studied. Further investigations are focusing on the hot end materials found in current engines. The main purpose of these hot-end tests is to ensure that no hazardous effect will occur to turbine blades, as a result of some – possible - reactions of combustion products of alternative fuels or from any traces of unknown compounds present. Also, the effect of the alternative fuels thermal stability will be evaluated, for example, on the performance of the control system as well as the propensity of the fuel to form gums and lacquers in the engine fuel injector (polymeric materials).

Concerning aircraft system integration, the selected alternative fuels will be tested on existing fuel systems. Issues are related to: sealing, corrosion, pumping, filtering, water compatibility, microbial contamination, gauging, and permeability, among others. Effects of temperature, altitude, water content/icing on general pumping performance, gravity feed and ice blockage of inlet strainers, will be studied. Further investigations are dealing with a more general material compatibility with fuel in the aircraft.

Concerning safety, standards, and regulations, all the data and experience gained in producing, handling, and testing the alternative fuels will be collected and analyzed with a main focus on safety issues. Then, the potential impact on the regulation and standardisation schemes will be established in an operational manner.

Acknowledgment

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Diesel Fuel Stability Test Method Correlations for Contemporary Fuels

By Paul Richards and Steve Cook
Research Fellows
Innospec Fuel Specialties

Over the last few years, following step changes in both engine technology and fuel specification, there have been increasing reports of diesel engine fuel filter plugging and injector internal fouling. At the IASH 2009 Conference in Prague, Czech Republic, Drs Burgazli and Cook presented some of the work they and colleagues had been conducting to identify possible causes of these issues. This presentation highlighted some of the techniques being used to characterise the deposited material, in particular temperature programmed oxidation. The fouling and filter plugging issues have not gone away. Rumours abound about possible causes and laboratory tests have managed to generate deposits that are similar to specific isolated field problems. However, analysis of customer supplied samples has shown that these incidences do not account for the vast majority of reported cases and there are a number of possible causes of injector and filter fouling. Further, these causes may be due to single fouling sources or to synergistic multiples. A team of top scientists at Innospec continue to collect and analyse samples from the field and within the last year have published four peer-reviewed papers on this work. A typical analysis of an injector needle (Figure 1 and 2) showed via EDAX analysis that the deposits were mainly carbonaceous (Figure 3).

Figure 1 Typical fouled injector needle

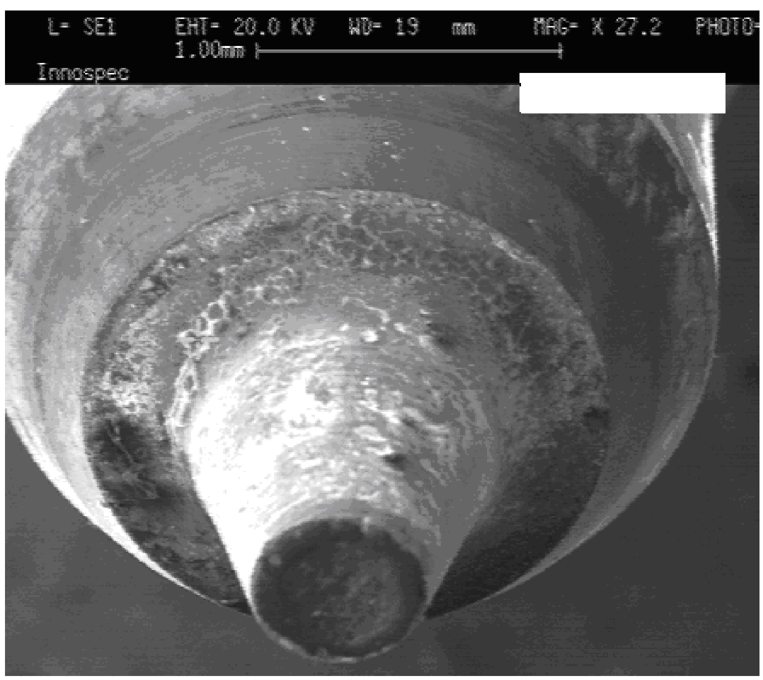

Figure 2 SEM of injector needle

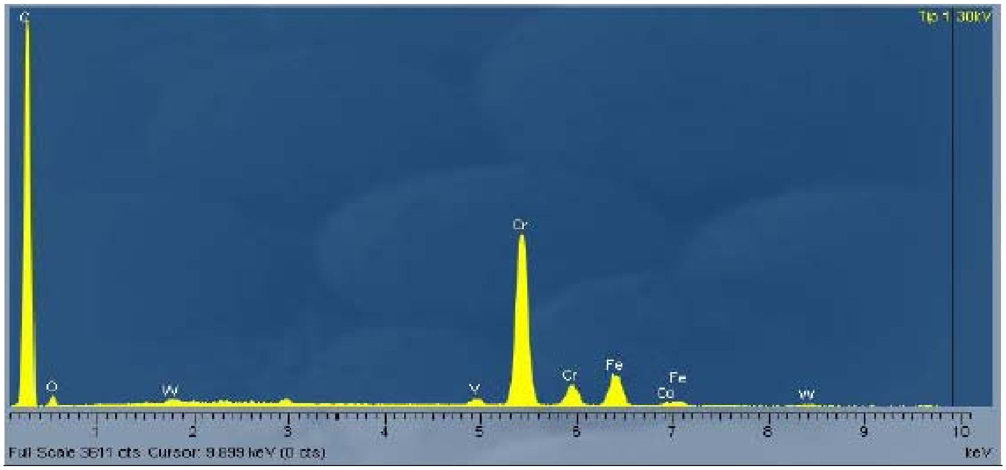

Figure 3 EDAX of injector needle

The presences of metals that have been linked with deposit formation were far from common. An example of this is shown in Figure 4. This is one of only two occasions in which sodium was detected and then only in trace quantities.

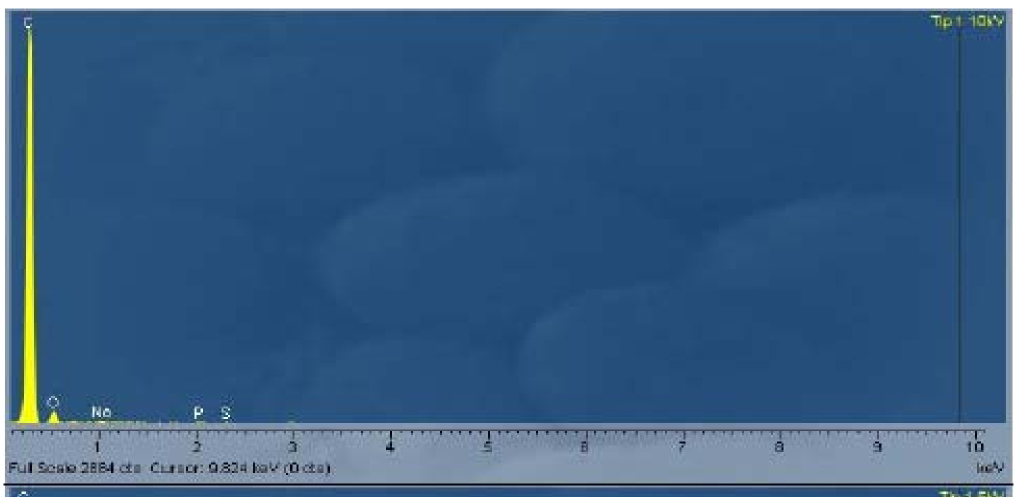

Figure 4 EDAX of injector needle

The conclusions presented in Prague were that current tests do not correlate with fuel stability in use in latest-generation high pressure fuel injection (HPFI) equipment. This has been recognized by CRC and a working group has now been set up to consider developing a new test method. Innopsec has been developing a high temperature rig to undertake such studies (Figure 5).

Figure 5 A Static rig capable of generating high pressures and temperatures

It was also concluded that investigations must include methods of stressing the fuel and analytical methods for detecting the outcome. Indications are that one underlying problem is the stability of the fuel when repeatedly subjected to the high pressures and temperatures found in modern HPFI systems. Work is ongoing to reproduce the problem using both real fuels and model fuels in laboratory-based equipment. An increasing variety of analytical techniques are also being employed to characterize the deposits from the field and further results will be published in due course.

1. Barker J., Richards P., Goodwin M. and Wooler J.
   "Influence of High Injection Pressure on Diesel Fuel Stability: A Study of Resultant Deposits"
   SAE 2009-01-1877, June 2009
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   SAE 2009-01-2637, November 2009
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   "Temperature Programmed Oxidation as a Technique for Understanding Diesel Fuel System Deposits"
   SAE 2010-01-1475, May 2010

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Other upcoming conferences and symposiums are included in the calendar on the IASH web site

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