Centre for Air Power Studies (CAPS)
Forum for National Security Studies (FNSS)
37/18

IAF'S MAIDEN FLIGHT TAKES WINGS WITH INDIGENOUS BIO-JET FUEL

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Keywords: Bio-Jet Fuel, Biofuel aircraft, Indian Air Force, AN-32, 17 Dec 18

On December 17, 1903, a gasoline engine[1] powered, manned aircraft got airborne at Kitty Hawk, North Carolina, USA. This event is marked in history as a momentous occasion which heralded the beginning of an era of heavier than air, controlled flights. Although the first flight lasted just 12 sec and travelled only 120 feet, it never-the-less revolutionised the way humans travelled and altered outcome of military campaigns.

On the same date, 12,000 kms away and 115 years later, the Indian Air Force took a novel step by flying a Russian military aircraft on indigenous sourced bio-jet fuel, developed using home-grown technology and produced from native agroforest produce. With this, India has joined the league of select nations to have developed, tested and certified a single step HRJ[2] process to convert non-edible oil into biofuel for use on military aircraft It is also the first nation after USA to have its own standard (BIS[3]) for bio-jet fuel or synthetic sourced aviation fuel. Prior to undertaking this flight trial, bio-jet fuel (and its production process) had undergone a series of exhaustive evaluation by various agencies before being certified by the CEMILAC[4] as 'fit-for-use' on aircraft. After this maiden flight, subsequent trials and certification by RCMA[5] as airworthy, biomass-derived bio-jet fuel using this technology has the potential of becoming a key component in Indian aviation industry's strategy for reducing operating cost and environmental impact. The IAF is funding the entire testing and certification program and also providing its aircraft and engine test facilities. If the mission is successful, IAF has the potential to generate a continued demand for bio-jet fuel and drive the development of a sustainable eco-system for its supply.

Bio-jet fuel and IAF's vision

The maiden IAF flight of December 17, 2018 was flown by highly qualified test pilots from the prestigious Aircraft & System Testing Establishment (ASTE), under the supervision of

Air Officer Commanding, Chandigarh. The bio-jet fuel used for the flight was produced from Jatropha oil. This non-edible Tree Based Oil (TBO) came from seeds collected by tribals and framers from Chhattisgarh and extracted by CBDA[6]. Thereafter, the oil was hydro processed by CSIR-IIP[7], Dehradun using a single step patented HRJ technology developed by them in 2009. Since May 2018, IAF along with CSIR-IIP, DGAQA[8], quality control experts from Oil refineries[9] and RCMA (F&F, FOL) had been carrying out extensive tests on the bio-fuel including wide-ranging series of performance ground runs on the aero-engine. Based on inputs from these tests, flight clearance certificate as laid down in DDPMAS-2002[10] was issued by CEMILAC last week. The testing and certification process is in-line with internationally accepted and approved procedures[11], which is a pre-requisite to fill or fly any aircraft with bio-jet fuel. According to Dr S Kale, Regional Director, RCMA (F&F FOL), the fuel produced by IIP's technology has properties identical to conventional crude based aviation fuel and is fully miscible.

The consolidated test results, performance data and process document from this test flight and earlier ground trials would be used as inputs to formulate the Indian standards for bio-jet, namely - specifications for ATF containing synthesised hydrocarbon fuel - that is being prepared by BIS. On promulgation of the Indian Standards, use of bio-jet blended fuel by civil/ military aircraft would be possible. On completion of the entire testing process on AN-32 aircraft, and notification of new standards for blended fuel, the IAF may decide to examine and certify the use of bio-jet fuel on other fixed and rotary wing aircraft, including fighters. The ultimate aim is to prove the indigenously technology and endorse it for use across various aircraft fleets without having to pay the foreign vendors/ OEM[12] for testing and certification.

Driving Technology Infusion

Military aviation has traditionally spearheaded technology. The technology demonstrator flight of December 17, 2018 has proven IAF's ability to bring to forefront, the drawing board design and lab scale research products. This bio-jet fuel technology was developed by CSIR-IIP in year 2009 and tested at various national and international academic research labs between 2011-13. However, the research institute had difficulties in finding a willing partner to demonstrate its path breaking product. Now with the IAF providing the funds, equipment, facilities and manpower for its' testing and intervening in policy framing[13], an animate platform has been provided to transform this indigenous effort to a point from where it is ready to move on a path to commercialisation.

However, scalability of bio-jet fuel is still an issue. Presently, very few organisations are involved in the collection and processing of non-edible oil seed. The supply chain is sporadic and estimates/ data on availability of feedstock

limited to those stated in academic research papers. Therefore, driving this project beyond demonstrative flight trial would require consolidated efforts from many central ministries and state governments. For e.g., the IAF would require over 3,000 Kilo Litres of biofuel annually just for operating the AN-32 fleet with a 10% biofuel mix. Later, if IAF decides to fly fighter and helicopters also with bio-jet, the demand would go up substantially. Add to this the requirements of the civil aviation to offset the requirements of CORSIA[14], the demands could grow exponentially very soon.

According to Mr S Sarkar, project officer at CBDA, the state of Chhattisgarh has the potential to supply over 10,000 MT of oil from 110 thousand hectares of under-utilised land. Another biofuel expert from the Ministry of Agriculture & Farmers Welfare explains that India can meets its target of 5% bio-diesel blend and 10% bio-jet blend by adopting a state/ region-wise distributed model for collection and production of oil seeds. The biofuel production can be improved further by multi-cropping cultivable land and dovetailing existing agro-forestry programs for increasing oil seed production/ collection. However, this would require policy initiatives to be taken by the state/ central government to ensure and maintain a reliable and cross seasonal regular supply of oil seed.

India's extremely high dependence on imported crude to satisfy its energy demand is a strategic millstone for financial analysts, political strategist and military commanders. Our country relies heavily on petroleum products to fuel its expanding transport sector needs. An increase in consumption of hydrocarbons not only drains valuable forex, weakens strategic outreach and impedes growth but also is a major cause for environmental pollution. Biofuels have the capability to offset these shortcomings and the requirement to have a focussed policy driven approach from the government can, thus, not be over-emphasised. The major spin-off of this increased demand of bio-jet fuel would be a surge in economic activities at grassroots level, helping better remuneration for tertiary farm produce like tree based oil and rise in associated earnings of tribal and marginal farmers.

The An-32 17 December flight is a small but vital step involving many central ministries and departments in demonstrating synergy towards realising the national aim of reducing dependency on imported crude and safe guarding the environment.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

Notes

[1] Smithsonian National Air and Space Museum, "Inventing a flying machine- Engine," https://airandspace.si.edu/exhibitions/wright-brothers/online/fly/1903/engine.cfm, accessed on December 12, 2018

[2] Hydro-processed Renewable Jet or HEFA (Hydro processed Esters and Fatty Acids) converts raw vegetable oils to bio-jet in presence of hydrogen passing over a catalyst.

[3] Bureau of Indian Standards, is a national standards body of GoI established for the harmonious development of the national standards, marking and quality certification of goods and services. It also partners with other international certification and accreditation authorities in developing methods for testing and marking.

[4] Centre for Military Airworthiness & Certification is an Internationally recognised airworthiness certification centre for providing certification support to indigenous developments. Also works in tandem with DGCA for approvals for civil aviation requirement.

[5] Regional Centre for Military Airworthiness (Foundry & Forge, Fuel Oil Lubricants) is located at Bangaluru and responsible for certifying materials casting, rubber seals, forging, fuel oil and lubricants for use on aircraft. The centre works. The Regional Centre operates under CEMILAC

[6] Chhattisgarh Biofuel Development Authority is a statutory body setup to promote plantation and cultivation/ collection of Jatropha seeds for producing biofuel.

[7] Council of Scientific & Industrial Research- Indian Institute of Petroleum is a leading research & development laboratory in the field of hydrocarbons and related industry

[8] DGAQA- Directorate General of Aeronautical Quality Assurance

[9] Bio-jet fuel was tested at Quality Centre of IOCL, Panipat and RORL, Jamnagar

[10] Design, Development and Production of Military Aircraft and Airborne Stores is the governing document for all design, development and production activities related to military aviation.

[11] ASTM D4054, issued by ASTM International USA, defines the standard practice for testing evaluating and introducing new aviation turbine fuels and fuel additives.

[12] Original Equipment Manufacturer of aero-engine like Motor Sich JSC, Ukraine and Ukroboronprom, Russia, Pratt & Whitney, Canada, etc charge test and certification fee for incorporating any modification or changes to existing consumables or spares.

[13] The IAF has approached many ministries including MoP&NG, MoF&CC, MoA&FW, MoCA F&PA and MoCA for supporting the project

[14] ICAO, program called Carbon Offset & Reduction Scheme (CORSIA) for International Aviation is aimed at reducing the carbon emission from commercial airlines across the globe