



National Institute of Technology Karnataka

CAPSTONE PROJECT PROPOSAL

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Title of Project:

Use of Hydrogen as an aircraft fuel.

Introduction:

- On a typical day 1,300 planes take off and land at Heathrow Airport, and keeping that going requires around 20 million litres of jet fuel every day.
- That's the equivalent of filling up your car around 400,000 times.
- It's a massive operation, with fuel piped to the airport direct from refineries and then stored at two facilities known as fuel farms, when it comes to fuel, airports around the world are having to have a major rethink.
- Sustainable Aviation Fuel (SAF) - fuel that does not come from fossil fuels - is one option. Airlines are already using it, usually blended with regular jet fuel.
- For airports it's simple to supply SAF - it can be delivered via existing pipes. But many doubt whether SAF can be produced cheaply enough, or in large enough quantities, to meet the needs of the airline industry.

Another Option,

So, there is much interest in hydrogen, which can store a lot of energy and, when used as fuel, does not produce any CO₂.

But there are many problems in using hydrogen as a fuel

Problems to face:

- To be of any use to the aviation industry, hydrogen needs to be in its liquid form, which involves chilling it to minus 253C.
- Handling a liquid at that kind of temperature is immensely challenging. Given the chance, liquid hydrogen will "boil-off" and escape as a gas - potentially becoming a hazard.
- So, tanks, pipes and hoses all have to be extra-insulated to keep the liquid cold.

Past work and Solution:

1)Air Liquide:

France's Air Liquide has a lot of experience in this area. For around 50 years it has been supplying cryogenic hydrogen to the Ariane rockets of the European Space Agency (ESA).

The company produces more than a million tonnes of hydrogen a year and as well as fuelling rockets, its hydrogen is used in trucks and all sorts of industrial processes.

"This gives us a very strong background in technology and industrial knowhow in this field," says Erwin Penforis, a senior executive at the company's global hydrogen business.

Over the past three years, in partnership with Airbus and France's biggest airport operator, Group ADP, Air Liquide has been investigating the potential of hydrogen in the aviation business.

2)Universal Hydrogen:

One start-up, Universal Hydrogen, says it has a solution. It involves doing all the tricky parts of handling hydrogen away from the airport, probably at the facility where the gas is actually made.

The company has developed special tanks to hold liquid hydrogen (UH calls them modules), which can then be trucked to the airport. The modules are designed to slot straight into the aircraft, where they can be plugged into the propulsion system.

No need for pipes, hoses and pumps.

The modules are extremely well insulated and can keep the hydrogen in its liquid form for four days. Two modules would hold 360kg of hydrogen and would be able to fly an aircraft 500 miles, plus an extra 45 minutes of flight time in reserve.

Universal Hydrogen is modifying a regional airliner, putting in a fuel cell that can convert liquid hydrogen to electricity and connecting that up to electric motors that will drive the propellers.

Larger doors are being fitted so the modules can be loaded into the plane. If all goes to plan, test flights will start next year

It's not clear yet whether hydrogen will become a mainstream fuel for aviation. Aircraft powered by hydrogen are still in the early stages of development.

Unlike current planes, which can store fuel in their wings, hydrogen planes will have to store their fuel in the fuselage, cutting space for passengers.

In addition, there is also the question of whether there will be enough environmentally-friendly, green hydrogen to meet demand.

What we are going to do in this project:

- We have to think about a storage device that can store liquid hydrogen at low temperature, because storage of liquid hydrogen is one of the main problem.
- Also, we are going to think, how this can be made economical.
- As hydrogen planes will have to store their fuel in the fuselage, this result in the cutting space for passengers. Designing a fuel tank inside the plane which does not affect the space for passengers and also does not increase the weight of the aircraft.