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Silver & Hydrogen Peroxide Engine Proposal

Emissions from flights are one of the leading causes of air pollution and have a potent impact on the climate and atmosphere. Emissions from aircraft are released high into the atmosphere making their impact more detrimental compared to other forms. There are thousands of flights every day, meaning hundreds of thousands of pounds of fuel are being used daily. This presents a very clear need for innovation, as currently the earth is heating up at a frightening pace. What we are proposing is the use of a chemical reaction between highly concentrated hydrogen peroxide and silver, otherwise known as cold rocket fuel, to power a commercial aircraft at a speculated lower cost and less emission of pollutants. This change in fuel will require an engine capable of harnessing the energy it produces. Since commercial airplanes, such as the CRJ 700 use aviation kerosene as their fuel of choice, a restructure of the engine itself will be required to support the change in fuel, as well as to accommodate any byproduct that the chemical reactions may cause.

The Canadair Regional Jet (CRJ) 700 was created by Bombardier in the late 1990s. The main purpose of the CRJ is to be for regional flying. For example, if you wanted to fly from New York City, JFK to Minneapolis, MSP, most likely you would fly in a CRJ jet. Since the CRJ is a short to medium-haul plane it could seat anywhere from 70 to 78 passengers. The CRJ 700 entered service in 2001 and since then there have been roughly 322 firm orders (Bombardier CRJ700 Jet, nd). Major airlines like Delta Connection Inc., American Eagle, and Air Canada operate the CRJ 700. In early 2005 Bombardier announced the CRJ 700 LR. LR means Long Range. The CRJ 700 LR has increased range, increased maximum take-off capacity, and increased fuel capacity (Bombardier, 2005). The CRJ is powered by two General Electric CF34-8C engines.

The first time General Electric used a CF34 was on the Air Force A-10. It is the same engine, but it was called the TF34 (Chandler, 2012). Later, used on the first CRJ's, there have been about 10 different versions of the CF34. Other regional jets also use the CF34 engines. The dash 8 variant produces roughly 14,500 pounds of thrust. It also provides 50% more thrust than the previous variant. Higher thrust to weight ratio (Propulsion hub, nd). The total MRO (Maintenance, Repair, and Overhaul) for the CRJ700 during 2021 was roughly $447,018,409.00 (2021 Bombardier, 2021).

In designing the engine, the dimensions of the original CRJ 700 were taken into consideration. The schematic given shows the new engine with dimensions of 25 inches of height, 200 inches of length, and 93 inches of width, which will predominantly be made from aluminum and aircraft grade stainless steel. It includes a catalyst outflow tank, connected to mixing valves. In addition to two mixing tanks for two possible chemical reactants during takeoff. One of the reactions will be hydrogen peroxide mixed with potassium permanganate which produces an aggressive reaction that will lead to a higher impulsive thrust. This reaction will be used for takeoff, where more energy will be required than regular flight. The other reaction will be between silver and hydrogen peroxide, which is mild when compared to the previous reaction. This will be used for the remainder of the flight due to its lower impulse thrust and energy production. Silver will be stored in an elongated chamber in the center of the engine. While the potassium permanganate is stored in the two chambers either side of the silver one. The gas produced by the chemical reactions are allowed to flow through a 15-inch silver tube, which in the schematic is depicted on top of the assembly. The gasses are sent directly to the motors to generate thrust, where sustained flight speed is the only requirement. The aqueous and gaseous byproducts are cycled through an impeller and a generator that are located inside of the silver chamber, which are used to charge high-powered batteries. Those batteries can thus be used to power motors or any other onboard avionics. As the movement of liquid and generation of chemical byproducts affects the weight distribution of the vehicle, ballasting tanks and valves are included underneath the assembly to make sure that any movement of mass is compensated for. Being that all the four mentioned components are made from some variants of aluminum or steel, all elements can be machine produced or lathed for the manufacturing process. Due to the relatively simple forms used by these designs, subtractive manufacturing like CNC milling would be the optimal option for manufacturing

Based on the research we've conducted, using pure silver to create cold rocket fuel requires 220Ibs of silver which costs 75,973.33 USD however, pure silver does not need to be replaced every flight. Hydrogen peroxide needs about 248 gallons and needs to be replaced every flight, costing about 46.26 USD. Combining that with the 200 pounds of Potassium permanganate required costing 450 USD puts your total to 496.26

USD per flight. Compare that to A1 gas used currently on the CRJ700 costing 3 USD a gallon and needing 3408 gallons to reach maximum fuel capacity makes the total 10224 USD. Making the cost of cold rocket fuel a lot less than A1 gas.

Some negatives about this would be the intense heat that would be generated after coming out of the exhaust. High-grade steel or material light and capable of withstanding such high temperatures would be needed to make sure warping of the exhaust doesn't occur. Such materials may prove costly, as the specific amount of heat that a large reaction such as this would create is not entirely known. Second would be the intense vibrations that could occur during flight due to the building up of heat in the engine. However, that can be solved with sound dampeners around the exhaust and by the engine. Lastly the cost of the materials used in the reaction may be volatile. For example, silver has seen large fluctuations in price in the past few decades, with changes in its price having the ability to massively impact the overall costs of running the engine. There's also the need to manufacture said engine in a large scale, to accommodate 100's of planes.

Although the implementation of the engine may prove to be challenging, its overall benefits outweigh the aforementioned negatives. Planes are one of the most widely used modes of transportation, while also producing the most CO2 and other air pollutant emissions per passenger when compared to the other forms. The commodity and reliability of planes will be hard to replace but creating an engine with a cheaper and possibly more environmentally friendly use of fuel will be largely beneficial in the long run. Costs of our proposed engine and engines already used by commercial planes will be competitive and, in the future, may become significantly cheaper, due to the ever-increasing prices of oil and gasoline.

There have been many failed and experimental innovations in the case of plane engines and fuel. In one case there was a plane which featured solar panels attached to the wings. It worked with varied success as conditions had to be optimal to generate enough energy and fuel the engine. One of the drawbacks was the use of very large wings that'll hold the solar panels to gather energy. These large wings were not only space-consuming but also very heavy. There's also been experimental research which uses sugar and converts it into jet fuel. Information available is limited but it uses Synthesized Iso-parafins (SIP) to convert the sugar into jet fuel.

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