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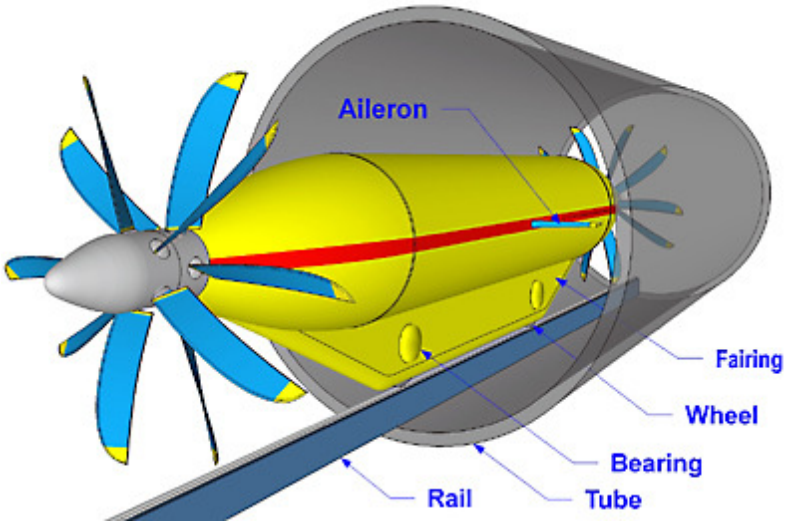
Engineering Work Starts on Supersonic H2 Tube Train with Praxair Funding

GOLDEN, CO - First proposed half a decade ago, work is now beginning on the prototype model of a supersonic vehicle that travels inside a tunnel with a hydrogen atmosphere.



Computer rendering of the supersonic tube train vehicle inside its tunnel. (Copyright 2013, Supersonic Institute)

Arnold Miller, Ph.D., president of the non-profit Supersonic Institute here, announced funding is now in place to start Phase 1 of a five-phase project to study and demonstrate a small prototype of such a vehicle that can transport cargo or people inside a large tube filled with a hydrogen atmosphere.

Miller said most of the funding for Phase 1 will come from Praxair, the largest industrial gas company in the Americas and one of the largest worldwide, with a cost-share contribution from Vehicle Projects, Inc., also of Golden of which the institute is an offshoot. He did not release any details about funding levels.

Vehicle Projects has developed several hydrogen fuel cell-powered rail vehicles, including mining locomotives and rail switchyard locomotives (H&FCL March 04, Aug. 09, June, Dec. 12); Miller described his supersonic hydrogen tube train concept initially five years ago (H&FCL Nov. 08, Sept. 09).

Miller told H&FCL that Phase 1 consists essentially of producing engineering drawings and engineering and concept designs, "mechanisms how it will work." He expects to finish that phase by the end of December.

If everything works out as planned, Miller expects to build a test tunnel and a 1.1 meter test vehicle - about 1/15th scale - in Phase 2. The tunnel would be roughly one kilometer long with an inside diameter of around 380 mm and with about 13 mm wall thickness, a project that he expects would take about a year.

Scaling up the prototype to a size that could carry 74 passengers, the tube would have an inside diameter of about 7 m.

Plastic Waterpipe for Prototype Tunnel

For the prototype tunnel Miller expects to use relatively inexpensive polyvinylchloride pipe of the kind frequently used as water pipes. The pipes don't need to be of pressure-vessel grade, Miller explains, because the hydrogen gas pressure inside the tube would be only marginally above atmospheric pressure: the basic idea is in case of a rupture or leak, the hydrogen gas would bleed to the outside rather than having air and its oxygen enter the tube, leading to a potentially dangerous, highly flammable hydrogen/air mixture.

A pre-publication version of a paper that Miller will present at the 5th World Hydrogen Technologies Convention in Shanghai in September and made available to H&FCL, explains what he has labeled "aerodynamic tunneling." It describes a vehicle that would travel at a maximum of 3,500 km/hour (2,220 MPH), in a hydrogen atmosphere inside the tube.

However, the first prototype will have a cruise speed of slightly above 1,225 km/h (760 mph), equaling Mach 1 in air outside the tube.

The basic idea is that a hydrogen atmosphere inside the tunnel would be aerodynamically more favorable than air; he has examined 24 different gases, and hydrogen exhibits the best "gas efficacy," a combination of factors such as decreased density, drag and viscosity. In the past, Miller has explained that because of hydrogen's lower density compared to air, sound travels much faster than in air; the net effect is that the onset of the sound barrier which has largely blocked the onset of supersonic planes, is delayed inside such a hydrogen-filled tube, permitting speeds higher than achievable in our atmosphere without creating the pressure buildup and sonic boom when a plane breaks the sound barrier.

H2 Atmosphere Runs Onboard Fuel Cells

The vehicle would be powered by fuel cells, and the hydrogen fuel to run the fuel cells would be scooped out of

the tunnel's slightly pressurized hydrogen atmosphere. Liquid oxygen would be stored on the the train for the fuel cell to generate electricity to run the counterrotating sets of propellers fore and aft.

In his new Shanghai paper, Miller describes the system like this: "A vehicle operates at a speed of 1 km s-1 in a hydrogen-filled tube at pressure of 103 kPa [3-5]. Within the tube, the vehicle levitates above a guideway on a magnetic field or gas film and uses propeller propulsion; it breathes fuel for fuelcell power from the tube, stores liquid oxygen onboard, and collects the product water as it operates. Vehicle speed inside the tube is subsonic at Mach 0.74, which corresponds to strongly supersonic Mach 2.8 for a land vehicle outside the tube and to Mach 3.3 for the same body hypothetically at 11000 m, a typical cruise altitude of transport airplanes."

A key part of Miller's proposal is what he says is the absence of an expensive propulsion infrastructure, such as high-speed train's linear induction motor. There is only the fuel cell on board of the vehicle, and "the propeller has no infrastructure cost." *Contact: Supersonic Institute, Valerie Traina, 303/296-4218 x 22; Valerie.traina@vehicleprojects.com.*