

Air Filtration for Fuel Cell Vehicles



The Hawai'i Natural Energy Institute (HNEI) is conducting research to develop novel filtration materials and air filtration technologies designed to extend the range of environmental conditions in which fuel cells can safely operate. The specific objectives of this project are to: develop the materials, hardware and protocols which will allow Fuel Cell Electric Buses (FCEB) to safely operate in Hawai'i Volcanoes National Park (HAVO) and to identify future applications of the technology.

Challenge & Significance

A major challenge to implementing fuel cell technology into transportation is the degradation in performance over time of the costly fuel cell power plant, partially due to air contamination entering the fuel cell from the environment in which it operates. The hardware, protocols and novel air filtration materials developed in this project will allow fuel cells to operate in harsher environmental conditions without suffering degradation in performance. The technology is also expected to extend the operating life of fuel cells operating in normal environments. Fuel cell technology integration into transportation has the potential to reduce dependency on fossil fuels, reduce global warming emissions and improve air quality for the majority of urban citizens.

Status & Accomplishments

- An air filtration test bed has been fabricated to quantify the performance of air filtration materials under simulated harsh environmental conditions.
- A novel Environmental Sensor Array (ESA) has been designed and fabricated to provide real time environmental conditions to the protective protocols for the fuel cell vehicles and to display real time environmental conditions to the driver.
- Commercial air filtration materials have been tested for effectiveness in simulated HAVO conditions.
- Positive preliminary results with novel air filtration materials indicate the potential to reduce operating losses due to pressure drop.
- Operational protocols have been developed to allow FCEB to operate in HAVO under harsh environmental conditions.

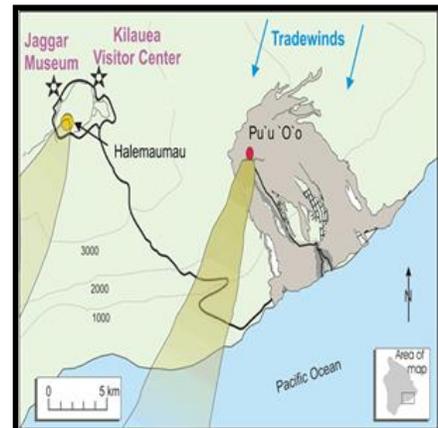


Figure 1. SO₂ plumes in Hawai'i Volcanoes National Park.

Contact(s):

Scott Higgins
808-596-3723
higgins@hawaii.edu

Richard Rocheleau
808-956-8346
rochelea@hawaii.edu

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Partner(s):

- [Hawai'i Center for Advanced Transportation Technology \(HCATT\)](#)
- [Hawai'i Volcanoes National Park \(HAVO\)](#)
- [Federal Highways Administration](#)

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Project Detail

HNEI has an ongoing thrust to develop a complete hydrogen infrastructure lifecycle, from production to end use, which will influence fuel cell technology. As part of this thrust, and in collaboration with the Hawai'i Center for Advanced Transportation Technologies (HCATT), the Federal Highways Administration, and Hawai'i Volcanoes National Park (HAVO), HNEI is planning to operate two Fuel Cell-Electric Buses (FCEB) in HAVO which will serve as an in-field demonstration of: the consumption of hydrogen within the larger hydrogen lifecycle context and, the operation of fuel cell vehicles in harsh environmental conditions through the use of a novel Environmental Sensor Array and operational protocols, developed at HNEI.

Environmental Sensor Array

The Environmental Sensor Array (ESA) is a novel device, developed at HNEI, which is being integrated into two FCEB. It consists of an array of electrochemical (SO_2 , H_2S , NO_2 , NO , HF , VOC) and environmental sensors (temperature, pressure, relative humidity) that monitor the real time environmental conditions and air contaminant concentration in: i) the FCEB environment from which the fuel cell air supply is drawn and, ii) the entrance to the cathode side of the fuel cell (post-air filter). The data will be fed real time into the onboard control system of the FCEB where preprogrammed protocols, developed at HNEI, will put the fuel cell in a protective shutdown mode if atmospheric conditions threaten the health of the fuel cell. The protocols will be based on laboratory experimentation with a custom air filtration test bed (Figure 2). The total contaminant exposure will be integrated to give a continuous estimate of remaining lifetime of the onboard air filter. This system of monitoring and reacting to the environment instantaneously promises to extend the lifetime of transportation fuel cells operating a wide range of environmental conditions.



Figure 2. HNEI Air Filtration Test Bed

Novel air filtration materials

HNEI is developing air filtration materials which are specifically designed to adsorb contaminants that are most destructive to fuel cells. Preliminary results show a significant improvement in adsorption capacity of SO_2 when compared with state of the art commercial technology.