CO2 SCRUBBING TO CONDITION GAS BY-PRODUCTS FOR AIRCRAFT FUEL TANK INERTING

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ABSTRACT

Aviation jet fuel is stored within fuel tanks on board a commercial aircraft for its propulsion system. The space above the liquid fuel within the fuel tank is known as the ullage. The ullage can contain reactive components, such as oxygen and/or fuel vapours, which can be a potential fire/explosion hazard. The term "inerting" refers to the process of depleting one or more of these reactive components to reduce this potential hazard.

Various inerting systems are known. The main approach is to displace the potentially explosive atmosphere in the ullage with an inert gas. Some known On Board Inert Gas Generation Systems (OBIGGS) for aircraft pass engine bleed air through an air separator module (ASM) to produce nitrogen enriched air (NEA), which is fed to the ullage. More recently, catalytic and engine exhaust inerting systems have been proposed. They do away with the ASM to save weight and to reduce maintenance. The catalytic inerting systems take oxygen and fuel vapour from the ullage and pass these over a hot catalytic bed to oxidize the fuel vapour to produce oxygen depleted air (ODA), which is fed to the ullage. Engine exhaust inerting systems take the exhaust gas (EG) from the engine and pass it through a heat exchanger to cool it to a suitable temperature before discharging it to the ullage.

The ODA is very similar in composition to the EG. The ODA or the EG has a high carbon dioxide concentration and a high water vapour concentration, but a low oxygen concentration. The EG may contain additional NOX since the oxidation takes place at a much higher temperature. Both carbon dioxide and water are not desirable. Carbon dioxide when dissolved in water forms carbonic acid and is mildly corrosive to materials used in the fuel tank. Water can affect components in fuel systems and lead to operational delays and increased maintenance activities. Thus, the ODA or the EG needs to be conditioned to remove the carbon dioxide and water from the gas.

This paper investigates a carbon dioxide scrubber that may be used onboard an aircraft in conjunction with a catalytic inerting system or an engine exhaust inerting system to remove both water and carbon dioxide from the ODA or the EG, respectively. The carbon dioxide scrubber is to be optimised in terms of the geometry and the operating conditions using Computational Fluid Dynamics (CFD) modelling. The CFD results will be validated with a test rig of the carbon dioxide scrubber.