Effect of Cabin Pressure on the Piloted Ignition of Combustible Solids

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Aircraft cabin pressure is typically pressurized to an equivalent "cabin altitude" of 8000 feet (75 kPa) or less to enable normal breathing of passengers and crew. Recent work on piloted ignition of PMMA in "space exploration atmospheres" indicates there is an increase in material ignitibility in sub-atmospheric pressure conditions. Due to the reduced pressure environment, the convective heat loss from the heated material to the surroundings decreases when compared to standard atmospheric conditions, the pyrolysate concentration near the igniter increases faster, and ignition occurs sooner. Our measurements also suggest that the critical mass loss rate at ignition is reduced at lower pressures. Experimental ignition time and mass loss rate at ignition data in normal air (21% O_2) over a range of pressures (10-100 kPa) are compared to a numerical model. Together, these results provide insight into the controlling mechanisms responsible for increased ignitability at reduced pressure: reduced convective heat losses (allowing the material to heat more rapidly) and a reduction in the critical mass loss rate at ignition (allowing it to ignite at a lower pyrolysis rate).